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I. *The age of the Volcanic Throats of the Upper Karoo Formations of South Africa.*—By Dr. John Shaw, F.G.S., F.L.S., Professor of Physical Science in the South African College.

[Read, 26th September, 1877.]

The surface contour of South Africa is not only of interest from a physical-geographical, but also from a geological point of view. It rises by terraces to an Upland Plateau which forms a belt-like tract, extending from the inland regions of the Colony, through the Free State, and into the Transvaal. There are three of these terraces, each bounded by a range of mountains. These ranges run more or less parallel to the coast. Geologically the coast belt of land is different from the first intramontane belt; that again from the second intramontane belt, which again is different from the Upland Plateau.

Taking a section from the Cape Flats and leaving out the Table Mountain mass as isolated (for such it must be considered) from the main structural disposition of the country, we find that:—

From the coast to the first range there is clayslate of a Silurian Age with mountain tops of Lower Devonian, commonly known as the Table Mountain sandstone. This brings us to the Drakenstein mountains. The first intramontane tract is Upper Devonian and is bounded by the Bokkeveld. The second intramontane tract is of Carboniferous age and is the Lower Karoo bounded by the Roggeveld mountains. The Upland Plateau belongs to the Upper Karoo, its geological equivalent being considered the Triassic of the secondary epoch.

The Tertiary Formations are but poorly represented in South Africa, consisting merely of isolated patches, such as the Tygervley sandstone of the Cape Flats, shell beds at French Hoek, at the mouth of Sunday's River, the Oliphant River, the alluvial deposits of the Vaal River, &c.

There is little deviation from the horizontal in the various strata, from the Cape Peninsula, onwards in a line to Leydenburg in the Transvaal. From this point to Delagoa Bay there is again a gradual terraced descent. From Leydenburg to Spitzkop we have schistose sandstone, thence to within 50 miles from the coast granite. From this to the coast felsite porphyry and, nearer the coast, tertiary sandstone.

Trap dykes occur all the way from the Cape Peninsula in a line to Delagoa Bay. They are, as determined by Cohen, Diabase. These dykes and vast sheets of trap are the characteristic features of the Upland Plateau. The scenery is a never-ending succession of cone-shaped mountains, table mountains, and flat uplands. The trap rocks have come to form the prominent features of the country from the long process of denudation to which South Africa has been subjected. The strata, through which they were thrust being softer, have yielded to wear and weathering, leaving the harder trap as protecting masses. In many parts the trap assumes the character of an aphanitic amygdaloid as in the Vaal Region; of a trap conglomerate as in a remarkable belt, which extends through the Western Province of the Cape Colony and Natal; or of a porphyritic trap as in Zululand. This is in all probability of the same age as the great trappean outbursts of the Upland Plateau.

The feature however of greatest interest to the geologist in the Upland Plateau is the presence near its inland boundary of the remains of volcanic throats or pipes. They are easily detected. Circular spots of a whitish soil are noticed. The soil on being examined is found to glisten with mica; masses of rocks foreign to the locality, garnets, and pieces of illemanite are turned up. In five at least of these throats diamonds have been got and are mined for. They are the Kimberley mine, Old de Beers, Dutoitspan, Coffeefontein, and Jagersfontein. The Kimberley mine now dug out to the depth of upwards of two hundred feet is the most famous diamond producing of these throats. Several of the throats in other parts of the Plateau have been examined, but no diamonds have turned up. The indications are all alike in every one I have observed; yet it seems as if the diamonds have no necessary connection with them.

These volcanic throats have nothing to do with the

trappean formations to which we have referred, and must have been formed subsequently. The walls of the Kimberley throat are the ordinary shales of the Upper Karoo, but there is a trappean layer conformable to these shales, which has been broken through also. The de Beer's mine has walls exclusively of Diabase. Dutoitspan has walls of alternate shale and trap. These facts are sufficient proof of my general position that the trap formations of the Upland Plateau are older than the volcanic throats or pipes. I have seen these pipes on the summits of trap covered hills in the neighbourhood of Hanover. The tuff contained in them has been determined to be palagonitic, and it has imbedded in it pieces of trap, sandstone, shale, trap conglomerate, granite, gneiss, mica schist, and chloritic schist. The argument for the relative age of the throats is therefore that the rocks of South Africa lie upon each other according to age, and that the older rocks are deeper down, and that the volcanic tuff in being thrust up got fragments of these rocks imbedded in it. It is not now absolutely necessary to believe that this tuff came up in a very hot condition. The walls of the throats are not much metamorphised, as they would have been in that case.

There can be no question, but the Karoo beds belong to the early part of the secondary epoch, and they are referred by Professor Owen to the Triassic Age. Similar fossil lizards have been discovered in beds in the South of Russia, which are undoubtedly Permian. Now the Permian is the last of the palaeozoic series, the trappean outburst of course happened subsequently to the Triassic Age. It was probably during this great upheaval that the mountain masses of South Africa were rent by huge fissures, through which the drainage of the inland regions is carried transversely across them. No more singular feature in the physical geography of the country is there than the narrow and tremendous gorges in mountain ranges, through which some of the South African rivers make their way transversely to the sea. No denudation theory can explain their abrupt and precipitous character. Denudation exhibits its work in gradual slopes, picturesque glens, and in open valleys. Cataclysm can alone explain the rending of mountain masses, such as has taken place in the ranges, which bound the great Upland Plateau of the Cape. In the

course of ages silently and gradually, denudation may remove continents. While we allow all this to modern uniformitarian geologists, such violations of the general laws of drainage in the river system of South Africa, by means of which rivers find their way through the heart of mountains, require some other explanation. The great trappean upheaval according to this view brought the period of inland lakes, which existed throughout the Triassic Age, to a termination. The waters of these lakes secured outlets by the enormous fissures of the mountains made by the upheaval.

The age of the volcanic throats may now be considered. The older trappean formations, which on the margins of the great inland lakes of South Africa assumed the character of a conglomerate from taking into the outburst fragments of rocks and pebbles, as we have seen, disturbed the strata of the Karoo series very little. The eruptions doubtless came from great depths, and while they broke up some parts, insinuated side-flows between strata. Extensive layers of rock would thus be only raised to a higher level, the trap forming a stratum-like layer conformable to the previous strata. The volcanic throats however have the Karoo beds tilted up. In the Kimberley mine they are tilted to an angle of from 30° to 75°. The inference is that they belong to a comparatively recent date geologically speaking. Where trappean outbursts are examined the horizontality is preserved, and we can only explain this fact by holding that denudation and drainage have carried away all trace of the disturbed strata, and that a long geological period has elapsed since these trappean eruptions. The argument therefore is in favour of the volcanic throats having been formed very much more recently, and possibly in the tertiary epoch.

There has only been one great upheaval since that of the secondary epoch, viz., that which has given to South Africa its scanty tertiary beds, already referred to. There is collateral support to the opinion, that this was probably the same as that identified with the outbursts of the volcanic throats. In the progress of the alluvial diggings along the Vaal in search of diamonds, the older gravels some distance from the Vaal and elevated above the river were the best and most in favour. Indeed in such a spot as the celebrated Union Kop diamonds were

not got on the surface, but at between four feet and ten feet in depth. Such an alluvial deposit could not be considered as recent, situated as it was some 80 feet above the river. The diamantiferous part of it even was obviously older than the surface four feet. Other examples could be quoted in support of the general position I have assumed.

And now that the diamonds have been traced to what may be considered as their head-quarters in certain volcanic throats, I think it will be conceded that the diamonds of the alluvial fields came originally from similar spots now obliterated by the Vaal river in its erratic courses through that region. These old gravels of the Vaal cannot be of more than tertiary age, and surely younger than the Eocene. The inference is therefore that the volcanic throats to some of which diamonds have been ultimately traced belong to the tertiary age, and possibly to the same period as the elevation of the sparse tertiary beds of South Africa.

II. *The Movements of Sea Sands and Bar Harbours.*— By Henry W. Piers.

[Read, 26th September, 1877.]

The Agulhas bank stretches along the southern coast of the African Peninsula and extends eastward as far as to Kafirland, and is believed to be gradually travelling further in the same direction. This, at the first glance, would appear to be an improbability in the face of so strong a current, as that which sets round the coast from East to West, called the Agulhas current, and which is so strong that, on two occasions when obliged to lie-to in north-west gales, the schooner in which I was, was carried back against the wind full fifty miles in twenty-four hours.

Now, where so powerful an ocean current prevails, there must of necessity be an eddy current running in the opposite direction, between it and the shore. In consequence of this law of nature, it is found that immediately along the seashore, when not modified by considerable irregularities of outline, there is a constant set of current from West to East. It is this inshore current, however feeble in comparison with the outer one to the West, that is the ever active agent in moving the shore sands of which our bars consist. The constant wash of the sea, even the smallest ripple, stirs up the fine sands, not a single particle of which can return to its original position, but is every moment pushed farther eastward before it can sink to the bottom again. This process may appear to be very slow and gentle, but it is very certain, and results in very important effects.

All our rivers opening into the Southern Ocean, except the Kie and Great Fish Rivers, have bars outside their entrance, or immediately across the mouth in the form of a sand spit from the West, being in fact a continuation of the sandy beach from that side. These are essentially composed of sea sand, and may be removed

by certain artificial arrangements, although at
able cost, at least such is my own view of the m

The inshore current in its course to the eastwa
with sand in mechanical suspension stirred up
immediate shore, deposits, or rather spreads the
as a smooth beach, unless obstructed by some im
capable of diverting its course seaward until th
ment be passed. One form of obstruction is
strong stream from a river, as at the Kowie an
Rivers. In such case the force of the river
sufficient to direct or divert the shore current
from the shore, until its power is exhausted
expansion eastward, where it becomes united
absorbed in the prevailing shore current. T
current, laden with sand, when forced out into d
there deposits a portion of the same in the form
running parallel to the beach, and immediatel
of the river's mouth, just at that distance fi
which the river current becomes merged in tl
sea. The depth of water on this bank or ba
course be regulated by the action of the sea
through the influence of wind or the tidal wav
can never rise above that point, at which the
the waves can be operative downwards. T
condition of these rivers in their natural stat
previous to the intervention of the engineer, wa
stream, forced over to the left or eastern bank
of the shore current, and a long spit of sand
from the western side across the wide open mo
rivers over which the tide could easily flo
commotion or disturbance of the bank.

Another description of obstruction causing
current to diverge seaward, is that of a solid reef of rocks
or the projection of a stone pier into the sea; the effect
in either case is, that which has been witnessed at Port
Elizabeth, in connection with the stone pier which has
caused a great silting up of sand where it was hoped to
protect the usual landing place from the ocean swell.
The *modus operandi* in this case is very evident. The
pier cutting across the direction of the shore current,
forces it out along its face, and round the extremity into
still water on the other side, where the sand carried
round with it is quietly deposited.

I may here state that before the Port Elizabeth pier

was commenced, I warned the members of the committee of enquiry, that such a result was inevitable. Unfortunately however, the opinions of some captains of trading vessels, as well as boatmen of experience, were assumed to be of more practical value, and so the mischief was done.

At the mouth of the Fish River there is no bar, because the eastern, or further side of the entrance, is a rocky promontary jutting out into the sea beyond the point on the western side. Nature has here set before us an arrangement which it would be well to keep in mind. The current from the river runs out along the face of the rock, and there the channel is deepest; from the opposite shore along sandy spit stretches across, over which as the tide rises, the water flows freely and without obstruction. It appears to me that if a groin were to be constructed running along the ridge of this sandspit for a portion of its length across the river, the flow of water would be confined to a narrower channel of exit by which the scouring action of the ebb-tide would be greatly increased, and consequently a greater depth of water would be secured for navigation by small craft. There is, however, a rock in the centre of the channel which would have to be removed, to admit of a free passage to any distance. At the mouth of the Kie, the arrangement I believe is somewhat similar, but on a larger scale, and with the same result, no bar.

In no case is the formation of a bar due to the accumulation of mud and silt from a South African river; none of our rivers are of sufficient volume to supply any ponderable material that is not immediately swept away by the tide, so that there can be no delta formed at the mouth of any of them, in fact it is only on the occurrence of abnormal freshets, that any mud or other *debris* ever reach the sea.

The bar at East London is essentially of sea sand, and is formed by the mechanical force of the river current, which pushes the sand from the beach out seaward into water sufficiently deep for its quiet deposit; and is therefore a detached bar. Originally the bar was a spit of sand stretching across the mouth of the river and forcing the channel over to the left or northern bank but permitting a free flow of the tide over it. By the construction of a river wall on the western side as

far as the position of the lighthouse, the stream is now conducted in a direct line across the shore current, forcing the sand outward to where it is deposited as a bar; when this point is reached the river current, losing its power to force a passage for itself further through the sea, it is deflected and turned to the left; and when the tide is rising, it returns into the river along the opposite side, and brings with it immense quantities of sand, forming an extensive bank, partially dry at low water, a considerable way up the north-east side of the river.

The stream running out along the river wall, is constant at all states of the tide, only varying in velocity according, as the tide is rising or falling. When the tide is coming in, the river current still continues its course outward along the wall; but after turning to the left outside, it circles inward again, and flows up the river on the other side. I have watched the trunk of a tree carried out by the stream as far as the bar and after turning to the left, circling round and coming back into the river, where it was again caught by the outgoing currents. This operation continued for more than two hours when it became too dark to observe it longer. The time occupied in completing each circuit was about twenty minutes. This was in 1862.

A remarkable movement of sand occurred at Port Elizabeth some years ago. After a severe gale of wind, which caused a violent surf to break on the shore, the whole of the sand at the boating company's landing place, was torn up and removed, leaving nothing but bare jagged rocks on which it was impossible to land, and for some time it became necessary to remove the boats to the neighbourhood of the Baâken River. Shortly after it was discovered that at a distance of two or three hundred yards from the shore a sand bank had formed, over which the large cargo boats could not float. This bank was evidently formed of the sand removed from the beach, which when torn up by the surf and floated out into deep water below the influence of the tidal wave gradually subsided. In the course of a month or two, as far as I can recollect, the sand returned to the old landing place and the outer bank disappeared.

III. *Remarks on Roridula Dentata, one of the Insectivorous Plants, illustrated by specimens.*—By Dr. John Shaw, F.G.S., F.L.S., Professor of Physical Science, South African College.

[Read, 26th September, 1877.]

The *Droseraceae* are represented in this Colony by two genera,—*Roridula* and *Drosera*. There are only two species of *Roridula*, but there are at least eight of *Drosera*. As plants they frequent the slopes of mountains and favour moist places. In Australia however, they start up after rains on dry sandy soil. Their special peculiarity as plants is the presence on the surface of the leaves of tentacular processes, which possess powers of movement, when irritated, and from which a viscous fluid exudes by glands, which are at the ends of these processes. The whole leaves as a rule become covered with the fluid. It is only of late that the use of this exudation to the plant has been determined. Insects had been often and often observed entangled in it, that they even perished in numbers on the leaves, decayed away, and were replaced by new victims. It has now however been conceded that the *Droseraceae* are predatory plants and live on the juices of the insects they entangle in the fluid they exude. The elaboration of this important discovery is mainly due to Darwin. He has experimented on live specimens in various ways, and has come to the astounding conclusion that these plants extract nitrogenous food from the insects by means of their leaves. The fluid is found to be a digestive solvent, by means of which the insects are absorbed and vanish in time into mere powdery specks and scales. As plants they have meagre roots, which can only serve the purpose of supplying water and giving them fixture.

Roridula dentata grows in the Cold Bokkeveldt mountains at a height of about 3,000 feet. It is a large shrub of from four to six feet, and is of a most unmistakeable

and striking appearance. The specimens I saw were literally covered with insect life, and a distinct hum was kept up by the larger ones struggling for release. The day had been a very warm one, which probably accounted for the numbers caught and still alive and struggling. I noticed that some shrubs had, fixed on old dry stems, spiders' webs—these insects finding it probably convenient to clutch out victims from accessible places. That the spiders go occasionally too far in doing this, is probable, as I found one entangled on a shrub. Some idea of the amount of the viscous fluid on the *Roridula* may be formed when I state that the whole shrub glistened in the sun as if saturated with dew.

It is strange that attention has not been more generally directed to this plant in South African botanical travel. Thunberg makes reference to it, and its power in snaring flies. He states that the farmers hang it up in their houses as fly catchers. This I saw also, the end of a branch stem being wrapped up in wet sand to keep it longer fresh. The other species of *Roridula* I have not seen ; it is said to occur on the Zondereinde and Tulbagh mountains. The genus *Drosera* is very well represented on Table Mountain in moist places. The flies caught on the *Droserae* are small, the plants being small and herbaceous. No other insectivorous plants except those belonging to these genera, occur in any part of South Africa ;—such as the pitcher plant and the *Pinginculae ;* and I have therefore thought it of some scientific interest to draw your attention to those we have.

Darwin had an herbarium specimen only of *Roridula Dentata* to examine, and I presume a very old one. In his remarks on it, he says, that he observed insects and the remains of insects in numbers, but no indication of any tentacular movement or clasping. I find, however, in my specimens that the tentacles are not only bent in the direction of the insects, but in many cases hold them. A northern genus *Monophyllum* has very sluggish tentacles, and Darwin supposes that the *Roridula dentata* is of the same character. This opinion will have to be abandoned therefore. This is the only really new observation I have to make in regard to the *Roridula dentata,* but I trust that the remarks I have set forward are of sufficient interest to have been brought before the notice of the Philosophical Society.

IV. *Notes on the Devonian and Ash Beds of the Karoo and Gouph.*—By W. Prosser, F.G.S.

Having spent the greater portion of a year, in the Karoo and Gouph, and having had an amount of leisure, together with horses and vehicles at his disposal, the writer has had unusual facilities of studying the geological formation of these portions of the Colony. And, having, moreover, made in Europe with his own hands, a considerable collection of palæozoic fossils, his labour was much shortened by previous experience, and the difficult task of identification and classification was much lightened thereby.

Before entering on the more technical portion of the subject, let us for a few minutes, recount what has been done by others, to clear up the tangle of the particular rocks of the Colony, to which your attention will be directed this evening, namely, the (*a*) Lower Devonian; (*b*) Upper Devonian, and (*c*) Felspathic Ash Beds.

In the years 1857-8-9, Mr. Wyley, a gentleman who had had a long experience in geological field-work in connection with the geological ordinance survey of Ireland, was appointed geological surveyor for the Colony. He made several long journeys through the Colony with the view of deciding the age of its rocks and the commercial value of its mineral productions. These labours he recorded in the shape of a very valuable MSS. geological map of the Colony. This map is accompanied with numerous sections and long Parliamentary Reports. And, taking into consideration Mr. Wyley's long experience among the palæozoic formations of England and Ireland, and the means which he possessed of comparing notes with so many European workers in the same department, his views deserve great weight at our hands. In the multitude of councillors there is wisdom. This is especially the case in geological researches; here, accumulated testimonies are essentially necessary in order to arrive at the truth. And, as it is unjust on our part, to ignore the labours of others, and alike

detrimental to the advancement of true science, we should endeavour in all our work, not only to freely acknowledge any assistance we may receive from others, but also to connect our results with theirs. The palace of scientific truth requires the co-operation of many workers, and the efforts of any one ordinary mortal are too feeble, and the span of life too short, to effect any material change by his isolated exertions. Nor must the labours of Drs. Atherstone, Rubidge, and Pinchin, in the eastern part, and Mr. Dunn's be forgotten. Altogether a large amount of geological work has been done here, during the last 30 years. And as evidences of this work, we have now three maps of South Africa indicating its geological systems ; namely, Mr. Bain's, Mr. Wyley's, and Mr. Dunn's ; we have all three before us.

And the writer is at present engaged in the pleasant but difficult task of collecting the mass of reliable information which is now scattered in so many channels, with the view of arranging them into a readable shape, and to form a Geological Handbook of South Africa.

Andrew Geddes Bain, in 1859, published a series of papers which appeared among the transactions of the Geological Society of London. These papers were prefaced, with an account written by himself, on the character and order of the rocks of the Colony. These introductory remarks show a very considerable amount of acumen, and evince a rare power of systematizing observations, and, considering that Mr. Bain had received no technical geological or mineralogical education, nor had the opportunity of studying the physical aspects or fossil remains of European analogues, they reflect the very highest credit upon him.

All honour to such pioneers in science, as Smith and Bain ; men who are at once the architects of their own fortune, and literary fame. William Smith, of England, journeying in pursuit of his calling as a landsurveyor, was enabled by keenly observing and classifying facts, to lay the foundation of the modern system of the regular succession of the stratified rocks, and thus prove himself to be indeed the father of modern geology ; and A. G. Bain, while he traversed the Colony as a road-maker, was able by close observation to fairly classify the rocks, which compose the southern portion of this great continent of Africa.

Although necessarily imperfect, and incomplete, Mr. Bain's remarks, the result, by the bye, of 38 years of observation, are worthy of careful study, and any of us who may work in the same field, should not fail to mete out to him, his due reward, and acknowledge the good foundation he has laid. With the sanction of the Librarian, I am enabled to lay the book on the table for your perusal. I would here suggest to Mr. Thos. Bain, his son, upon whose shoulders it is pleasing to think, that, the geological mantle of the father, has fallen, that, if possible, the original MSS. and sections, if still extant, should be taken care of, and placed in the custody of some society.

The Hex River Mountains present very favourable spots for commencing the study of the known stratified rocks of the Colony. On their southern flanks, we have, as an accessory, a fault which has caused an upthrow of at least one thousand feet, and which gives an excellent section of beds, some of which abound in organic remains.

By means of the Beaufort West Extension Railway, this district, in common with the Karoo and Gouph, is easily accessible from Cape Town ; and in the following paper, the exact spots will be indicated, where fossils are most prolific.

The writer's first acquaintance with these Hex River beds, commenced in September, 1876 ; since that time he has had repeated opportunities of visiting them. Still, he must confess, that, his knowledge of this large group is but very limited and imperfect ; to thoroughly explore this important series, a residence of some weeks on the spot would be necessary ; but there can be little doubt, that a fine collection of palæozoic fossils could be obtained, and much light thrown on the Devonian, if not also on the Silurian age of this Colony, by such an examination.

The Hex River valley itself, is well worth a visit ; but its highly inclined metamorphic rocks, overlaid by tabular sandstones, apparently of the Table Mountain group, and its caves containing Bushman drawings, must be left, for another occasion.

The rocks requiring our immediate attention, are those closing the upper end of the valley, and forming the Hex River Mountains, and which mountains form the boundary between it and the Karoo.

I. The fossiliferous strata, are first seen, about a mile

beyond Mr. Meiring's house, and opposite the railway brickyard. At this spot, the surface of the ground is strewn with remains of brachiopods, and trilobites; of the former, *spirifera spiriferoides, orthes, leptænæ,* and *strophomenæ,* are abundant. In some cases the test is perfect, and spirifera coils are sometimes seen; among the crustaceans, *phacops candatus,* chiefly prevail. I provisionally denominate this the PHACOPS bed.

II. About a mile further on, towards the mountain, and near its foot, and along the circuitus road constructed by Captain Rainier, another series of fossiliferous beds crop out.

Here sandstone beds are literally covered with large winged *orthes, spiriferæ,* encrinite stems, *leptænæ,* a few trilobites of the phacops type, and starfish remains appearing among them. Masses of this fossiliferous sandstone lie along the western side of the road inside the elbow made by the road. And as the stone is of a friable nature, a slight tap of the hammer breaks the lump into many fragments, and at the same, time exposes fine hand specimens of the hidden treasures. On the eastern, or mountain side of this road, a fine section of these fossiliferous beds appear.

Perfect casts, of both valves, lie scattered about; and occasionally perfect petrified casts of the shells themselves drop out, as clean as those seen on the shores of Table Bay. Good internal casts showing muscular impressions and hinge teeth, are also found here; but, as is commonly the case, with sandstone beds, tests are scarce on account of the paucity of calcareous matter in the waters depositing them.

III. Another locality where fossil remains of similar bivalves are found in an excellent state of preservation, is about two miles further, on the same road and about half way up the hill, and at the point of junction between the new and the old road. Here, the sandstone has a thicker bed, but its identity with that in the curve near the bottom of the hill, is beyond a doubt; one fact alone proves this, it can be traced in one continuous line along the hill side. This is Wyley's "SPIRIFERA bed" as will be shown presently.

The same strata, containing the same remains occur, along the same road, on the other side of the watershed, and about five miles distant, and two miles west of the

Klein Straat. The locality is easily found from its being at a beck, which the road crosses. Some large guard stones placed here by the road-menders, abound in the same class of fossils; this is the same "spirifera bed."

IV. Another most interesting spot, and one yielding, in greater abundance, remains of a more decidedly palæozoic character, such as trilobites, is at the mouth of the Long Tunnel, near the summit of the Hex River Mountain. Here, are impure, compact, hard, and thick-bedded, limestone, abounds in the remains of these crustaceans, chiefly homalonotus; fragments of their carapace are everywhere to be seen. Here a tail, there a body lobe, there a cheek or palate plate. He who seeks in any part of the world, for a perfect trilobite, with the head, thorax, body, and tail portions articulated together, may have to look for a long time. Africa is no exception, to the rule.

The reason of this is evident. Like that of the cray-fish, lobster, shrimp, or *limulus* of the present day, the external skeleton of the trilobite, soon becomes disjointed after death, and the several parts fall asunder, whitening the beach of the sea whose waters have helped to decompose the tissues, and batter the whole into its several parts. And, just as but few whole cray, cuttle fish, or lobsters, can now be found on our shores, so also these ancient sea-beaches scarcely ever yield complete uninjured specimens of the trilobite.

But, of perfect pieces, the rocks at the mouth of the long Tunnel, and the heap of debris which lies near, presents a great abundance; and the locality is well worth a visit, nay more, repeated visits from the collector of palæontalogical fossils. These beds I denominate the DEVONIAN, or HOMALONOTUS, LIMESTONE beds.

The Verloren Valley, fifteen miles further north, and lying between Hex River and Karoo Poort, is a synclinal of the "spirifera" beds. Here, near the farm-house of Verloren Fontein, the writer has found similar large winged spirifera, in the same sandstone beds.

Being anxious to compare these Hex River beds with those examined and described by Wylie on the northern flanks of the same group, near Karoo Poort and Gydow Mountains, thirty miles away as the crow flies, the writer went, from the Straat and traversed the very same ground as Wylie did, staying at the same farm-house, Mr. Jan van de Merwe's. The most cursory examination

of the rocks around Hottentot's Kloof, and especially on Jan van de Merwe's farm, proved beyond doubt, that these also formed an anteclinal of the same spirifera beds, as the two localities just mentioned. The Cold Bokkeveldt, on the Doorn River Farm, has also yielded remains identical in every particular with those found at the Tunnel, or the trilobitic limestone beds. Summarizing all these facts, it may be accepted beyond doubt, that, the range of mountains reaching from the eastern side of Hex River, through Mr. John Meiring's farm, past the tunnel, Captain Rainier's road, over the Hex River Mountain pile, through Verloren Valley, on past Jan van de Merwe's, Hottentot's Kloof, into the Cold Bokkeveldt, to beyond Doorn River, and at no great distance from Patates River, are all of the same age: Devonian, according to Wylie.

And, permit me here to draw attention to the fact, that, the various rock sections of the different railways, which are now being constructed in this Colony and in Natal, offer unusual facilities for obtaining organic remains of numerous strata which would otherwise be unapproachable and hidden from view. The loose rock got out from some of the workings have already yielded a rich harvest.

We would therefore strongly urge upon the Government, the necessity of appointing some competent person, to make a careful examination of all the loose material in the formation of the various lines, with the view of obtaining more complete suites of fossils from the different localities, and thus obtain evidences which would help to clear up some of the haze which hangs over some of the geological horizons of the country. Unless the work be taken in hand soon, it will be too late, as many of those beds which are most prolific in remains, such as the shales, will soon marl, and be converted to their original form, mud, and all the evidences which they would otherwise yield, be lost.

Mr. Wylie mentions the following fossils, as being found by himself in the Karoo Poort beds:—*Leda inornata*, *Orthis palmata*, *Tentaculites crotalinus*, and stems of encrinites. More rarely, rings of the large *Homalonotus*, and an obscure fossil, resembling a small star-fish, probably the head of an encrinite; *Ophiocrinus Strangeri*, and two or three more stellate bodies, possibly, single joints of the arms of the last, with their radiating feathery appendages: also four

species of *spirifer antarcticus, Sp. Orbignii, Orthis palmata,* and *Strophomena Bainii.* These latter, occur in a bed of sandstone, which runs all over the districts in question, and which is easily identified by its mineralogical structure, and abundance of these remains. Indeed, the individuals are so numerous, that they form a perfect conglomerate of shells, or rather casts of shells, two or three inches thick.

So striking is the likeness between the whole appearance of these beds and their European equivalents, that, were it not for the discomfort consequent on the glare and intense heat of the African sun, and the presence of such strange forms of vegetable life around, the writer could scarcely help thinking that he was still exploring fossiliferous beds, on some pleasant hillside at home.

In addition to the above the writer has found the following fossils:—Corals:—*Petraia bina;* Crustaceans:—*Phacops,* several species; *Palæaster Africanus,* provisional name; Spines of Echini. Brachiopods. *Septæna* new species; *Strophomena*—species; *Orthis testudinaria;* Lamelli Branchiata, *Modiola*—species; *Orthonotanasuta.*

Permit me here to state, that two very serious obstacles present themselves at Cape Town, to any of our young geologists who wish to make themselves thoroughly conversant with physical science generally, and of geology and botany, in particular. I refer to the great absence of technical works treating on the present and past forms of the flora and fauna of the rest of the world. A reference library, composed of technical works, such as, the memoires of the Palœontographical Society, and the Transactions of the Geological Society, would be valuable guides to the geological student. Secondly, although the Museum contains the nucleus of a good collection of African fossils, yet because the majority of the specimens are unidentified, they are of little, or no assistance in the identification of fossils. Well-directed efforts, resulting in the possession of standard technical works, bearing on the nomenclature of mineral or organic forms, or the obtaining of named type specimens, would be productive of much good, especially to the members of our society, and through them, to the community at large.

Every identified fossil or mineral, coupled with its matrix, is a land mark, a signpost, on the road towards a solution of the rocks. Each specimen tells his own tale,

which is a portion of a whole history, and the accumulated testimony of all the species and varieties of a formation, gives nearly all the information which the geologist and mineralogist can desire. Hence, it follows, that every fossil, which is lost to the public, is, as it were, an explorer's notch, lost on the bark of a tree in a dense bush :—one chance less of threading one's way out of the almost inextricable labyrinth, a finger post less, pointing the way out of the maze.

The question of the age of these deposits has been a subject of dispute. When sending to Europe fossils of this age, but from another locality, Mr. A. G. Bain took them to be Silurian. The weight of opinion, expressed by those members of the geological society, who examined these fossils, was in favour, of their being Devonian. Mr. Wylie considered similar beds, cropping out at the Karoo Poort, to be more Devonian than Silurian ; his chief reason being the fewness of species of trilobites present,—three species only having been found,—while the Silurian rocks in Europe give 23 species, and many varieties. This, together with the fact, that, no decidedly characteristic Silurian specimens had been found,—although it was equally true, that, no specific Devonian forms either had appeared—inclined him, also, to the Devonian theory. It might, however, be said, that, this opinion, having been given 20 years ago, by the gradual change which must necessarily prevail in such a progressive science as geology, might not hold good to-day. So late however, as 1872, only a few years ago, the previous decision was confirmed, by Mr. Rupert Jones, a no mean authority, on the examination of similar fossils from the Witzenberg Flats. (See Quarterly Journal Geological Society, February 1872.)

With his usual caution, Mr. Wylie, hesitates to pronounce any beds he had seen in the Colony as unmistakably Silurian ; but he intimates, at the same time, that, the South-African Silurian would be found along the littoral zone of Table Mountain.

And the writer ventures to state his regret, that without the most undoubted evidences, yielded only by the discovery of decidedly Silurian organic remains, Mr. Dunn should have called some of the rocks around Malmesbury, by that name. And, again, if they are Silurian, why call them "Malmesbury" beds?

The labour of geological workers in South Africa, is greatly facilitated and lessened, by taking note of the marvellous persistence of many of the leading features of its rock formations. This is patent in the district in question. We will, for the guidance of future observers, name four of these parallels.

(1). The BRACHIOPOD BED, presents a remarkably fine horizon, for the Devonian rocks. It retains its lithological and fossil characteristics over a large tract of country. Its identity is perfect, over an area, of, at least, 400 square miles, and in all probability, over a much larger extent. The writer has been enabled to examine it, from Hex River to the Groot Straat, and thence to Verloren Fontein, on the Ceres road, from Karoo Poort; and, again, ten miles further north, along the road leading from the Draai to Ceres, past Hottentots Kloof, and over the Karoo Poort Mountain. Besides all this, the southern side of the Witte Bergen, also the valleys of the Lange Bergen, and Zwartz Bergen, in the Oudtshoorn and Prince Albert regions have outcrops of the same beds.

It is very desirable to further explore these beds, so as to fix their northern and southern limits; as well as to ascertain, whether they are at all times conformable to the their subjacent and superincumbent rocks.

(2). Beyond the Hex River Mountains, and above the Devonian sandstones, a white band of compact siliceous rock occurs, and is seen over immense tracts, of the Karoo and Gouph. This bed, surrounding hillsides and mountain tops, like a white ribbon on a ground of neutral grey, presents a very striking feature in the various landscapes of the district where it occurs. Following the various synclinals and anticlinals of the Upper Devonian rocks, it at one and the same time, shows the fixedness of the agencies which were at work in the southern hemisphere, during their deposition, and gives a very convenient horizon, for the field worker. This siliceous bed has everywhere the same mineralogical structure, is creamy-white in appearance, and lies uniformly about 60 or 80 yards *below* the felspathic ash; and thus it affords a horizon, marking beyond question, the upper beds, of the Upper Devonian rocks. From its first appearance on the eastern face of the Hex River Mountains, and not far from the Klein Straat, most of the hillsides from Rietfontein in the Karoo, past Baviaan's Krantz

and Zoute Kloof, on the one side, and the ridges running parallel to the Witte Bergen through J. J. Nell's, Soanapoel's, Grootfontein, Blood-river farms, on the other side of the Karoo and Gouph, as well as many parts of the Prince Albert district, are marked, with this persistent, and well-defined, bed.

Standing alone, among the strata of the Karoo and Gouph, by its peculiar lithological characteristics, as well as by its striking appearance, this bed is of great service in defining the age of the district where it occurs, and is also of especial use in those localities, whence the felspathic ash beds have been removed.

It may be stated incidentally, that gold is traditionally associated with it ; but, after calcination and trituration, I have failed to see, any colour even. It is however, of economic use for lining lime-kilns, as it is easily fusible in the presence of lime, and thus forms a vetrified surface inside the kiln ; a fact of some commercial importance to a Colony which imports all its fire-bricks.

(3). Accompanying this bed, and almost immediately overlying it, is a very constant deposit of the black, or per-oxide, of manganese. Although the ore is not sufficiently pure or crystalline, to be of any commercial use, its presence in the form of a stratum, is of service in conjunction with its cogener, the silicious bed, in marking the age of the surrounding deposits. The very constant character of this bed will be understood, from the fact, that it is traceable for at least fifty miles, in an almost unbroken line. The origin, age, and agencies concerned, in the deposition of the ores of manganese, as seen in the Colony generally, must be left to a future paper.

The Devonian calcareous and sandstone beds, described at the commencement of this paper, are succeeded by shales and sandstones, possessing new characters. The beds crossed by the formation of the railway near Pieter Meintjies Hochte or more strictly speaking, the eastern end of De Wet's farm, yield organic remains in abundance. Mud shales more or less stratified with sandstones, present, on cleaving, innumerable fragments of plants of the Upper Devonian, or lower carboniferous period. Portions of ferns, stems of equisetaceæ, bits of wood, literally cover the face of every layer of the stone. The extreme thinness of these layers, together

with the homogeneous character of the deposit, and the gentle ripple markings left by those ancient waves, are fair evidences of the quiescent character of the waters whose muddy sandy bed these rocks must have formed at one time. These are the Wittebergen Sandstones.

These remains, in all probability, point to the commencement of the coal-measure period. But the vegetable remains, are, in almost all instances, fragmentary; possibly indicating, that this is not the spot on which the plants grew, but one to which they were transported by currents or floodwaters. The absence of roots also tends to comfirm the same idea.

It occasionally happens, that, some of the deeper beds having thin bands of shale between them, contain carbonized wood (*equisetaceæ*) yielding coal to the thickness of from an eighth to a quarter of an inch. In some of these cases, the owner of the land, ignorantly supposing that the external indication is but an evidence of a deeper workable seam, and the wish being father to the thought, commences mining operations, which it is needless to say can only result in a fruitless expenditure of money. One good almost always accrues from such ill-advised efforts, namely, the bringing to light fossil remains, which would otherwise be inaccessible. A much better plan to follow, in prospecting for coal, is to carefully study the sequence of the beds, as seen in exposed rock sections.

Some of these small isolated seams of carbonized wood may be seen in the rocks under notice, at Rietfontein railway, quarry Karoo; also at Hartebeste Fontein Farm; also at Armstrong's, Wagenmaker's Kraal; Beaufort Division. These are of no possible commercial value, and possess no other than a purely geologic interest.

It is a question of considerable scientific as well as commercial importance, to ascertain the spot where these plants and trees grew; and whether they were in sufficient abundance, to form in any one spot, useful beds of coal.

By working cross sections, one from Zoute Kloof, (Mr. Greef's) to Johannes Meiring's Farm, along the Buffel's River; and another from Geelbeck Farm, (Mr. Jan Jacob's) past Fliege Fontein, and J. J. Nell's Farm, along the Geelbeck, repeated anticlinals of the same beds are seen, and yielding the similar fossiliferous remains.

Mr. Thos. Bain and Dr. Atherstone, have also quoted fossils of the same genera in the same geological horizon, near Prince Albert, a long way further east. These, were in like manner, found "in close proximity to the trappean conglomerate of the Karoo."

All this evidence points to the fact that the so-called "Karoo beds" are the equivalents of the Lower Carboniferous beds, and they prevail over a great portion of the Karoo, and much of the western parts of the Colony.

Immediately above these shales and sandstones, is a rock, which has been denominated the stumbling block of all African geologists, we refer to the

TRAPPEAN ASH CONGLOMERATE.

It is in appearance a compact greyish blue rock, having a conchoidal fracture, and containing small crystals of altered felspar. As it weathers, it assumes a brown colour, and not possessing a perfect homogeneous character, masses of the rock are left standing on the ground, like sentinel bushmen. Indeed it is called the Bushman's rock, probably from the fact that the bushmen found these vertical gravestone-like masses, excellent cover, whence they could make a stand against the early settlers. Properly quarried, its bed gives excellent building stones of almost any size, and much of the marvellous fertility of the soils of the Karoo, is due to the disintegration of this remarkable rock. The average depth of this trappean conglomerate in the Karoo is 200 feet. It forms low mountain masses, and being harder and less easily abraded than the surrounding sandstone shales, it stands out in bold relief, like grant steps on the hill sides. The name trap is derived from the Swedish word, *trappa* or steps.

The vegetation of these hills of felspathic trap is scanty, but very unique. Here we find stunted *Mesambryanthemums*; numerous kinds of *Euphorbias*; the peculiar "Ghap" (*Stapælia*) in at least a dozen varieties; the long and short "Cos natchie," or *crassula*; and the remarkable "Wonder blad;" with several kinds of "Air-plants," "Canne doet's" or *aloes*, and the "Zoute bosche." And these hills afford shelter, by their wildness and desolation, to wild-cats, hyænas, jackals, baboons, meer-cats, wild-ostriches, and occasionally to Burchell's Zebra.

Two nuggets of gold have been found near the edge

of the felspathic ash bed of the Karoo. One nugget, now lying in the South-African Museum, was got near the Draai. Its discovery led to the formation of the Cape Gold Mining Co., having for its object the exploration of that neighbourhood for gold. After sinking a shaft 3 feet in diameter, to a considerable depth, presumably, in the hope of striking an auriferous quartz reef, and being unsuccessful, they abandoned all further attempts. Another nugget, said to have been embedded in quartz, was found on the Cragga farm, near Constable. A search made here by Mr. T. Bain, and others, commissioned by the Government, resulted in failure. Both these places, the Draai and Cragga, are just at the junction of Witte Bergen sandstone and the Ash Beds. And it is, to say the least, a striking coincidence, that, both nuggets were found in localities, which, although they lie thirty miles apart, are similarly situated with regard to the ash beds in question. In the very imperfect search which the writer made in the Karoo, he found no trace of the precious metal. But, it is worthy of note, that the fine gravels of rivers running through it, yield in washing, comminuted rubbies and garnets in considerable quantities.

The trappean rocks are divided into two great subdivisions, according as felspar or hornblende is a component part. When felspar predominates, the rock belongs to the felspathic series, when hornblende is proportionately great, a hornblende trap, or greenstone is formed. Having this hornblendic base the presence of distinct glassy crystals of felspar, quartz, or calcar-spar may entitle a rock to be called, greenstone porphyry. In like manner, clay-stone porphyry is a trappean rock whose base is clay, and which contains crystals of hornblende. In this case, alumina must be conjoined with felspathic and hornblende crystals.

But to return to the trap of the Karoo. Each observer has given this rock a different name. Mr. A. Geddes Bain called it "claystone porphyry;" Mr. Wylie's name was "trap conglomerate;" Mr. Dunn has denominated it the "Dwyka conglomerate." As it shows no evidence of having any claystone character, either as a derivative or by direct deposition from clay or mud, and, as it has none of the usual porphoritic characteristics, Mr. Bain's name is inadmissible. Mr. Dunn's designation, the result

of a hasty inspection of a few hours' stay, on his way to the Diamond Fields, simply implies, that it is a conglomerate rock, which he considered to be typically represented on the Dwyka River; a by no means typical spot. His name gives no inkling, as to what he considers the matrix in which the pebbles are imbedded, to be. And, I would venture to remark, that it is of some importance to the cause of science, not to give local names to great deposites. It is better to let them remain for the time a blank, and be unnamed, unless sufficient evidence is at hand to give them at once, a name which would indicate their proper position among the known rocks of the world. For instance, such names as "Dwyka conglomerate," "Karoo beds," "Malmesbury beds," "Enon conglomerate" and "Namaqualand Schists," convey no idea of the character, or geological horizon of the deposits to which they refer, while they emburden the geological maps of the Colony with a meaningless nomenclature.

Mr. Wylie has on the other hand, however, committed himself, both to the nature of the mother rock, and its general appearance, by his name, "trap conglomerate."

Mr. A. G. Bain considered this as a volcanic rock belched out of some huge crater in the interior. Mr. Thomas Bain, in his report on Gold Prospecting in the Karoo, dated the 5th January, 1874, speaks of this rock, as seen near the Draai, as follows:—"Here the rocks suddenly have a metamorphosed appearance, sandstones highly siliceous, and ordinary shale converted into chert, from the intense heat of the trap conglomerate which crops out about a mile from the Draai." And again, "Its erruptive origin is without a doubt, as you find embedded in it, fragments of granite, gneiss, clay-slate, quartzite and Silurian shale; in fact bits of all the rocks underlying the place where it protrudes; and it is evidently the cause of of the wonderful contortion and folds in the strata of the Zwarte and Witte Bergen. Another remarkable feature about this formation is that it forms the line of demarcation between the marine and fresh water fossils of the Colony, which has led some geologists to imagine it to have been the boundary of a vast inland lake." Here Mr. Bain thus commits himself to the following conclusions:—

(1). That this formation was deposited while in a state of intense heat, for the adjacent beds have been

metamorphosed, shales being turned into "chert," for instance.

(2). That its erruptive origin is proved beyond a doubt, by its conglomerate character.

(3). That the wonderful folds of the Zwarte and Witte Bergen have been caused by its erruption.

(4). That this conglomerate forms the boundary of the marine and fresh water deposites of the Colony.

Mr. Bain further confirms these views in his notes on the geology of the Western Districts which appeared in the *Cape Monthly Magazine* for September, 1877. And quoting his own words he writes: "I consider it to form the base rock of the Zwarte Bergen, or the backbone range of the Colony, as it is called, which during its intrusion or upheaval, contorted and twisted the masses of quartzite, into all sorts of shapes, while in a plastic state.

Dr. Atherstone in a paper published in the *Cape Monthly Magazine*, for July, 1871, speaks of this deposit as plutonic or semi-plutonic, and considers it to be intrusive in its character.

It is evident, from the foregoing extracts, that this formation, has, for many years, occupied the attention of many enquiring minds, and therefore I need not apologise for bringing it under the notice of this society, so as to find, if possible, a solution to this hitherto unsolved problem.

In order to enable each member to form his own judgment on the subject, the whole facts of the case will be laid before you. And, while availing himself of the labours of others, as far as the extent of the deposit is concerned, the facts relating to its appearance, deposition, conformity and general appearance, are those observed by the writer himself, and they may be relied upon as accurate. And, taking the whole of the facts of the case into consideration, it is impossible not to arrive at the following conclusions:—

(1). That the deposit in question, is an altered felspathic trappean ash.

(2). That it must be removed from the plutonic where Mr. Dunn has placed it, or the volcanic, where Mr. Bain has put it, to the aqueous, series.

(3). And, that, consequently, it does not in any way partake of the character of dykes.

(4). That it marks an era in the geological history of the South-African continent, during which important changes were effected in its fauna and flora.

The Silurian and Devonian systems of Great Britain afford many examples of felspathic ash beds; but we know of no instance in which the embedded pebbles give it such a decidedly conglomerate character, as the African deposite presents. Most of the trappean ash beds are purely volcanic, but the deposite under our notice, presents unmistakable evidence of a secondary character.

Firstly:—It is in all cases conformable to the carboniferous shales below, and to the sandstones, above. It would be quite impossible to name all the localities where this may be seen. But some of the most striking and accessible spots, extending over an area of some hundreds of square miles, will be named.

Around Pieter Meintjie's Fontein this rock may be seen in a dozen places resting on the shale. Among the finest sections are those presented by the high range of Pieter Meintjie's Hochte, along the Pieter Meintjie's Hochte Fault, by means of which, the trappean ash and its underlying shales, have been cast down, at least a thousand feet. For a distance of eight miles along the perpendicular escarpment of the face of this fault the ash and shales are conformable. The same conformability is also seen, on the western and vertical side of the two nameless hills, which, at Pieter Meintjie's Fontein, stand like giant sentinels, guarding the entrance to the ash covered plains stretching eastward, along the Karoo and Gouph, for hundreds of miles.

The same conformability is evidenced by numerous sections along the line of country extending through Bullover farm, opposite Matje's Fontein, and on to Zoute Kloof, a distance of forty miles.

But the finest examples of this ash, and its underlying shales, and overlying sandstones, *in situ*, are to be seen on the southern side of the plain of the Karoo, along the lands of Johannes Meiring, and through J. J. Nell's, past Hartebeeste Fontein, and Soanapoel's and thinning out towards the Dwyka River. Along this belt of country, the beds have been greatly disturbed, and they lie in all positions from the horizontal to the vertical. But, what I wish to draw your special attention to, is the fact, that, in whatever position the shale beds lie, the superincumbent ash

beds take the same. This is the case at Prince Albert, also; and Mr. Dunn informs me, that, in the far off district of Natal, the ash and the shale beds are, in his opinion, similarly conformable.

Besides all this direct evidence of conformability, there is not a single instance, where the ash beds protrude *through* the shale beds; nor is there a single example of the ash lying *between* beds of shale; nor have I seen anything like a local disturbance in the underlying shale, which has not extended itself also into the ash beds. Such evidence, therefore, clearly disproves the supposition, that, this trappean ash has been cast out from dykes. Nor was the matter composing the rocks in question, laid over the surface of the shale beds, in a molten state, for the following reasons :—

(1). In no case do the shales or sandstones or even the ore of manganese show metamorphosis. The shales adjoining the ash differ in no respect from those adjoining sandstones or limestones; nor are the sandstones quartzoze, except near the surface, where the change is more apparent than real. True it is, that, a bed of black oxide of Manganese runs parallel with the ash bed, and not far from its junction-line with the shale. And the surface of the ground is often covered with the black sintery looking ore. This might possibly have misled some persons, and caused them to think that the blackness is due to heat, and not to the nature of the ore.

Again, the striking dissimilarity between this ash and volcanic intrusive rocks, is further shewn, by its constant conformity to its overlying rock. Everywhere it is capped by the sandstones. These two rocks are seen *in situ* near Constapel; also 20 miles further east, around Matje's Fontein, and in numerous sections on the Buffel's and Geelbeck, Rivers.

Nay, more, not only is this sandstone everywhere conformable to the ash beds below, but the line of junction shows no sign of change by heat. This is the order that the beds in question assume:

(1). Upperr Karoo Shales (Carboniferous).
(2). Ash beds.
(3). Sandstones Witteberqen.

The conformability of the sandstone beds with the ash beds, in all their distortions and dislocations, clearly proves that whatever disturbing cause has affected the ash bed,

could not have originated with that bed, but had its origin *after* the deposition of the overlying shales.

What the age of this disturbance was, the writer is not prepared to say, but it occurred after the deposition of the Witte Bergen, Zwarte Bergen and Lange Bergen ranges.

The mineralogical nature of the stone also militates against its being considered of direct volcanic origin, for it contains none of those crystalline characters which cooled igneous matter possesses. Let us recapitulate :—This trap rock behaves like a sedimentary deposit, for it is at all time conformable to the Carboniferous shales and sandstones below, and to the shales above. Like these neighbouring beds which are of undoubted aqueous origin, it has been disturbed by the same agent, and at the same era. Further, unlike igneous rocks, it is not crystalline ; and, as already been stated, nowhere intrudes through other rocks. Nor are there any disturbances coeval with its age of deposition. Still, some of these evidences are only negative, and chiefly indicate that such a deposit is not volcanic. But if not volcanic, it must be sedimentary, and deposited by water.

Fortunately, however, the rock itself gives undoubted evidences of a direct aqueous origin ; and that which has been a stumbling block, is in reality, a guide and a help to decied its character, namely, is its conglomerate character. Masses of rock are often, but, not at all times, embedded in this trappean ash ; of necessity they are portions of older formations. In all probability, also, they were fragments of the hills, bordering the ocean, whose muddy bottom these shales formed. Knowing that no disturbance had been effected in the shale and sandstone beds underlying this deposit, nor in the Devonian rocks underlying the shales, the shores of this old ocean must have been composed of a still older rock. And, on examination, the imprisoned masses are seen to be composed of granite, compact felspar, agate, and a dark rock which has the appearance of basalt. The elder and younger Bain have taken these rocks more as evidences of the plutonic character of the rock ; supposing that they had been hurled out of a volcano with the molten lava. An examination of any one of these boulders at once controverts that theory. Every embedded stone is quite smooth, none of them are angular ; occasionally one side of a boulder is sharp, on account of fracture, but one or more sides are always smooth. This is the case, too, whatever the size of the

stone may be, whether it be that of a hazel nut or a cube yard. This smoothness is a constant quantity, with all the varying kinds of rock names, holding equally true whether they be granite, compact felspar, or agate. Clearly, then, these boulders have not been cast out of a volcano, for in that case, they would have been angular. Nor do they exhibit the slightest evidence of having been subjected to heat, as they undoubtedly would, if they had been embedded in molten lava. However, not to weary you, with further evidence, there is every reason to conclude, that these stones, ranging from an ounce to a ton in weight, are no other than water-worn pebbles, and that they were deposited in this their present home, by the agency of water. Some persons have conjectured, that, the transporting agent may have been ice ; but the entire absence of striation, does not support this theory.

Following the line of the Witte Bergen this volcanic ash is seen in outlying patches, forming as a rule, bold, barren, clean-swept, rugged hills. But once past Rietfontein Poort, this conglomerate is no longer seen along the median line of the Karoo and Gouph On the northern, and north-easterly, boundary, along the route from Ceres to the Diamond Fields, past Geelbeck, and on the spurs of the Zwartz Bergen it forms lofty mountain masses. But the central portion of the country, between these two divergent lines, shows no trace of this rock, because it is overlaid by a newer one, the brown shales of the Upper Karoo.

On the three geological maps of the Colony, Messrs. Bain, Wylie, and Dunn's, this trappean ash deposit is represented as stretching from east to west, nearly across the continent.

This, although true in the main, is not strictly accurate. Its superficial continuity is broken by isolated patches. This want of continuity, is, however, more apparent, than real : for, these isolated spots are the result of denudation or upheaval. It is, however, extremely difficult to point out all the localities, for want of a much larger map of the Colony, than has yet been printed.

But there need not be much hesitation in declaring, that, the area covered at present by this originally volcanic deposit, although large, is but a small proportion of its first extent. It is difficult, if not impossible, to accurately estimate its pristine width ; but, after all the narrowing influences which have been at work upon it for

countless ages, from palæozoic times till to-day, the belt of exposed rock is still a broad one, measuring in one direction, not less than sixty miles, while its length, is between one or two thousand miles.

The age of this deposit is thus fixed. It was formed during the palæozoic era, and in the Devonian period. By "age" we do not mean the year, month, and day. Rocks have not this reckoning. True it is, that, during the deposition of the beds in the Karoo or lower and Devonian sand carboniferous strata which we have been describing, the sun rose and set in glory; the moon passed from the crescent to the full, and the sheen of the great Southern Cross, sparkled on river, lake, and sea; tide waves rose and fell on the shores of ocean, as at present; but there existed no creature of sufficient intelligence to take cognizance of these changes, and to record them. There is, therefore, no date, no annual calculation, of geological events; it can only be said, that such and such a rock, was deposited before, or after, some other rock. It is true, that this seems to be saying but very little. It seems to be little more than stating that page 9 occurs between pages 8 and 10. Still, this is all that can be done. And this task, simple as it may appear, is often a very difficult one, often too difficult of accomplishment. And to carry the simile of paging a book still further:—It is clear, that, arranging the loose leaves of a book in their proper order, would be impossible, to a person who had not mastered the signs and system of the notation of the language, in which the book was written.

Let us suppose, however, that the book has not been paged, and that the order of its leaves can only be ascertained, from their contents. This greatly increases doubt and labour. Again, a leaf may be missing, a source of further complication. But if the place of the missing leaf becomes occupied by an unnumbered page from a totally different book, from another volume the sorter's difficulty is increased tenfold. The labour of the geologist is often great; when he attempts, to as it were, arrange the rock formations of a country, in their proper order. His only reliable guides are the characters inscribed on them, in the form of impressions of plants or animals, or the fossil remains of the objects themselves.

The rocky leaves of the Great Stone Book of Nature are not paged, nor do they everywhere come in the same order; having been disturbed, torn, shattered, or

twisted about by the earthquake and the volcano, or removed away altogether by grinding glaciers, or the constant dropping of rain; dog-eared, folded down, and ripped, so to speak, as the leaves of old books frequently are, they often present sufficient scope for the highest intellects to satisfactorily arrange them. Fortunately, however, the task of deciphering these geological hyeroglyphics, is in itself so fascinating, that, it becomes a labour of love.

The age of the deposition of a volcanic rock, on the surface of the earth, cannot, as in case of a stratified one, containing organic remains, be told on examination of its internal character. Mineral characteristics, are not safe guides, as they may be repeated through all time.

In the case in question, however, the era of deposition is clearly defined by the surrounding stratified rocks. Without exception, this trappean ash is underlaid by the Devonian shales, while it is covered by the Witte Bergen sandstones. Numerous sections, where these deposits are seen *in situ*, attest to this sequence.

The writer would therefore suggest among other changes, that at least these should be made in Mr. Dunn's map:—1st. The Devonian beds, the equivalents of Hex River Mountains, should be stretched all the way to the Doorn River.

2nd. The trap conglomerate should be placed in the Devonian series, and among the sedimentary rocks.

3rd. A belt of country should be marked between the trap conglomerate and so called the triassic, or "Lower Karoo."

By the extrusion and re-deposition of this immense mass of felspathic ash, a very great quantity of felspar, and consequently potash and soda, its chief component parts, is laid on the face of the earth, and made available for the use of man. Both potassic and sodic salts, in a greater or lesser degree, enter into the constitution of all plants, especially cereals; hence, it follows, that, soils rich in these ingredients, provided they be not deficient in other essential matters, are calculated to yield large crops. And thus it comes to pass, that, in the cycle of the changes of the universe, and by the aid of man, volcanic matter, once hidden in the bowels of the earth, becomes fit food for the sustenance of man and beast. During long ages, the ash beds in question, have been oxidized, abraded,

denuded, ground down in nature's mill, until at length high hill tops have become disintegrated, their saline ingredients, have been loosened, and afterwards transported by water, till they became parts of the surface soil.

There are a great many points in the geology of Africa, which require clearing up, fit work for the members of this learned Society. Among these may be mentioned the following:—Are there any direct evidences in the form of morains, glaciation, or striation, of this continent having been covered by glaciers? And if this was the case was this ice period contemperaneous with that of the Northern Hemisphere? And proceeding from the surface to geological systems below, the following questions require answers:—

What is the line of junction between the carboniferous and the Denovian rocks below; and between them, and the triassic above, and are the three series conformable or unconformable to each other.

Does the southern part of the continent contain any true coal measures, and do they contain beds of workable coal of sufficient thickness and good quality, and especially of authracite and "cannel," the former for use in steamers, and the latter in the manufacture of gas?

Are these beds interstratified with beds of clay-ironstone, or hæmatite; and are these deposits of hæmatite within working distances of the coalbeds, so that Africa may hope at some future time to manufacture its own iron?

Are there not many more spots where manganese may be profitably worked?

These are but a few of the many problems which require solution, and on the satisfactory solution of which much of the future commercial prosperity of Africa largely depends.

Many other matters relating to comparative geology need working out. Among these are the following:—

Are there any laurentian and cambrian rocks in Africa?

What are the boundaries of the true Silurian system? Or are the Silurian and Devonian series merged into one system, without a break?

Does Africa present any parallels to the great periods of upheavals and disturbances of Europe and Asia, known

as Elie de Beaumont's eras, and which mark great cycles and breaks in the fauna and flora of the earth?

What are the limits of the diamondiferous trap, and under what conditions were the diamonds formed?

What is the co-relation of the diamond-bearing lava with other volcanic deposits in the Colony?

Have the dykes of the more northern portions of the Colony, any relation to the diamond bearing rock, or to the great faults which traverse the continent?

What are the boundaries of the auriferous rocks of Leydenberg? Do they extend northward to Sofala, or southward to the Transvaal?

These and many other most important points call for explanation at our hands. And it may yet be the good fortune, as it is the mission of this learned society, to not only clear up some, if not all of these obscurities, but also at the same time, reflect much light on the geology of the rest of the world, and lead to new and important results in its natural history. Earnest work, based upon facts, carried on in any part of the globe in the hands of master minds who are capable of generalizing and systematizing the whole, dovetailing one part into another, often leads to unexpected results, in the physical history of the earth. Any light which this society may be able to cast upon Africa, will assuredly be reflected on other parts of the world. Permit me in closing these remarks to say one word more. Practice must proceed theory; theory can only be established by facts; and reliable facts are only obtainable by work, actual work in the field; and each one of us may feel assured, that in such a new field, as this unexplored continent, is, intelligent and systematic work cannot fail to secure a rich scientific harvest.

I gratefully acknowledge the assistance which has been rendered to me by Mr. de Smidt, the Surveyor-General, for an enlarged blank map of the Karoo and Gouph. Without such a map it would have been impossible for me to have indicated the numerous streaks and patches under which form the felspathicash appears over so large an area. The Society and myself are also under an obligation to H. C. Pauling, Esq., for permitting a copy to be made of the distorted section of the Beaufort West Extension Railway. This section, by giving the heights of the various eminences and hollows, has saved me much labour.

V. *Note on the Colorado Beetle (Chrysomela decemlineata*, Say).—By Roland Trimen, F.L.S., F.Z.S., &c Curator of the South-African Museum, General Secretary to the South-African Philosophical Society.

[Read 28th November, 1877.]

In exhibiting specimens of the Colorado Beetle, I think it desirable to furnish the Society with a brief note on an insect which has of late become of such importance, both in North America (its native country) and in Europe, as to have called forth legislative enactments for its suppression.

The family *Chrysomelidæ*, to which this beetle belongs, is one of very great extent and world-wide in its distribution, though better developed in South America than elsewhere. Nearly all the members of this family are vegetable-eaters, and several species are notorious in Europe for their depredations on the leaves of cultivated trees and plants, such as the asparagus and elm beetles. No fewer than 580 species of the genus *Chrysomela* itself are enumerated by the well-known Swedish entomologist, Stal, as natives of America, and it cannot be doubted that many species remain to be discovered in the less known portions of that immense region.

It is characteristic of the sudden leap into notoriety and importance of the obscure little beetle under notice that, in Stal's Monograph of the American *Chrysomelidæ* (dated 1860), *C. 10-lineata* is placed among the "*species mihi ignotæ*" of that author, although it had been described by Say, its discoverer in the country of the Upper Missouri, as far back as 1824. Moreover, no hint of this particular "potato bug's" existence is to be found in the excellent new edition of Harris's "Treatise on some of the Insects injurious to Vegetation," published at Boston, Massachusetts, in 1862; although it would appear, from Dr. C. V. Riley's report (the best and fullest account extant) that the beetle had in 1861 already

invaded Iowa on its eastward march. The same entomologist, who has carefully attended to the insect's progress, states that it reached the Atlantic sea-board in 1874, its average annual rate of travelling being about 88 miles. The extent of ground over which it had spread is estimated at nearly 1,500,000 square miles, considerably more than one-third of the area of the United States ; and it has also occupied a large portion of Canada. It does not simply pass through a tract of country but permanently occupies it, as far as can be judged from experience dating from the commencement of its advance in 1859 or 1860 ; so that this beetle may boast a valid conquest of the land, and not a mere raid or victorious campaign.

The plants upon which the Colorado Beetle fed in its native locality have been ascertained to be certain wild species of *Colanum* nearly related to the cultivated potato and for these it is said still to show a preference. Although it attacks many other *Colanaceæ*, such as the tomato, ground cherry or Cape gooseberry, tobacco, petunia, &c., and has even assailed the cruciferous cabbage and plants of other orders, it appears only to take to them in default of species of *Colanum*, in this respect reminding us of our enemy, the Victorian *Dorthesia*, which, while managing to exist on so many different plants, is manifestly only at home on the blackwood and common wattle acacias, and on *Pittosporum*.

The amazing multiplication of the potato beetle is undoubtedly due in a great measure to the agency of man himself, who penetrated westward to the insect's native country, and clearing land of its natural wild plants, planted large supplies of the cultivated potato in their place ; in this way (as in all agricultural operations of the kind) inviting the various insects attached to the plant he was cultivating to increase and flourish. But the question why this particular insect should have triumphantly seized the opportunity, rather than any other species, is one of much difficulty ; especially when we consider that a very near ally, *Chrysomela juncta*, a native of the Southern and South-Western United States, which also feeds on wild species of *Colanum*, has never been known to attack the cultivated potato, although living in proximity to that plant for more than a century (see Dr. Riley's Report p. 120, Routledge's Edition, 1877.) From its close resemblance to the real Colorado

Beetle, this insect is known in the United States as the "*Bogus* Potato Bug."

It is certainly not for want of natural enemies that the Colorado Beetle so abounds. Dr. Riley enumerates, besides the somewhat doubtful case of the skunk, a crow and a grosbeak, ducks and fowls, and the common toad, as vertebrate devourers of the "bug"; while among articulate assailants there are a spider, a mite, a wasp, 6 sorts of lady-birds and 8 other beetles, 7 species of true bugs (*Hemiptera*), and 2 dipterous flies, all more or less predaceous on the potato destroyer.

While there is no doubt that in Europe there has been much unfounded apprehension as to invasion by this insect, it cannot be denied that a real danger exists, stray specimens of the beetle having been found in several parts of England and Germany. Prohibiting the importation of American potatoes, a course adopted by several European Governments, is unnecessary and ineffectual; the insect in none of its stages attacking or having anything to do with the roots or tubers which alone are imported. The larva of the beetle of course requires a perpetual supply of the fresh green leaves, and could not survive even a short voyage without food, but even were it to accomplish such a feat, the chance of so sluggish and helpless a creature ever reaching a supply of its natural pabulum when stranded on a distant shore is too remote to be worth considering. The case of the perfect beetle itself is however widely different; as it is comparatively independent of food, and flies with ease and activity. Mature specimens would find ready conveyance by ships, and there would be every chance of their flying on arrival to the nearest potato field. Various considerations of climate, new enemies, &c., would affect the question of the insect's permanent settlement in a new country, and the authorities seem to agree that considerable heat and drought are extremely unfavourable and even fatal to it. It may therefore be considered probable that, even should the Colorado Beetle reach the Cape by a steamer of the "*German's*" swiftness, a residence in this climate might not suit its complaint; irrespective of the fact that the scarcity and bad quality of our potatoes —which are indeed "small and few in a hill"—would be enough to disgust any beetle reared on fine American "vines."

VI. *On a specimen of the so-called "Bonnet" of the Southern Right Whale.*—By Roland Trimen, F.L.S., F.Z.S., Curator of the South-African Museum, General Secretary, South-African Philosophical Society.

[Read 28th November, 1877.]

The object which I exhibit to the Society puzzled me considerably at first sight. Mr. Whitford, who presented it to the Museum, pointed out to me, by scraping one corner of the specimen, that its structure was apparently identical with that of ordinary whale-bone; and then informed me that he had obtained it, with other zoological specimens, from an American engaged in the southern whale fishery. This sailor stated that he had taken the object from the whale's skin, but did not mention from what part of the body; he also said that he had previously seen similar warts or excrescences.

I found no mention of any object of the kind in the books which I consulted, until I referred to the British Museum "Catalogue of Seals and Whales" (by the late Dr. J. E. Gray) published in 1866. In that volume (p.p. 95, 96) Dr. Gray has reprinted a paper which he published in the Proceedings of the Zoological Society of London for 1864 (p.p. 170, 171), recording two apparently similar specimens, presented to the British Museum by Mr. Holdsworth. These were obtained at the Sandwich Islands (one from an American whaler), and at that locality were known to the whalers as a wart on the tip of the whale's nose commonly called the "Whale's Bonnet."

The specimen before us is intermediate in size between the two just mentioned, of which the larger is recorded to be 11 by 8 inches, and the smaller 6 by 2½ inches; the thickness not being stated. Its greatest length is 6¾ inches; greatest width 5⅜ inches; and greatest thickness

2¾ inches. Its outline is very irregular; the under surface by which it seems to have been attached to the animal's skin is comparatively flat, but with numerous shallow depressions and small circular pits; while the upper side is everywhere very deeply and most irregularly excavated, the intervening projections forming peaks and prominences of different shapes and sizes, but grouping into masses of which one (near the broader end) is considerably larger than the rest. This excavation appears to be much more developed than in the larger of Mr. Holdsworth's specimens, judging from the figure of the latter given by Dr. Gray.

The author quoted notes, the following opinions as having been given him by different persons touching the larger of Mr. Holdsworth's specimens, viz.:

(1). Mr. Holdsworth himself thought it might be a natural development characteristic of the species of whale.

(2). Professor Owen considered it as "a diseased action or tumour of the outer layers of integument."

(3). A "foreign zoologist" thought it might be caused by the adhesion of the barnacles called *Coronula*, or the irritation occasioned by the whale-lice (*Cyamus* sp.).

Dr. Gray considered the last supposition untenable, especially as regards the barnacles, of which he had seen numerous examples attached to the skin of whales, but which had given rise to no such horny excrescence as the "bonnet." Whale-lice were on the specimen when it was obtained from the whaler, but Dr. Gray suggests that they were merely sheltering in the hollow of it. The same zoologist notes that in the figure of the whale given in his memoir in Dieffenbach's "New Zealand" there are represented two rough rounded prominences, one on the front of each jaw; and he further expresses his belief (though he gives no reasons for it) that a prominence of the kind is to be observed in all the species of the genus *Balæna*. I have examined the figure referred to (vol. II., 1843; facing p. 177), and find on the middle line of both upper and lower jaws, near the extremity, the representation of a warty excrescence, looking like a rudimentary or perhaps worn-down horn.

The whale concerned is the Southern Right Whale, or Cape baleen whale (*Balæna Australis*), of which a considerable number used formerly to be killed on the coast of this Colony in the winter season. Mr. Warwick, in

a note published by Dr. Gray, states that out of 60 whales killed in False Bay during his stay only one was a male, the females coming into shallow water to bring forth their young. He mentions that he could not pass his hand through the gullet of a female which measured 68 feet in length.

The only suggestion which occurs to me in regard to the so-called "bonnet" is that it may possibly be a character peculiar to the male whale. The specimen figured in Dieffenbach's "New Zealand" was a male.

VII. *The Heat of the Sun in South Africa.*—By F. Guthrie.

[Read, 28th November, 1877.]

The object of the experiments only a brief summary of the results of which it will be necessary to give on this occasion was to determine the actual working power of the sun's radiant heat in South Africa. The experiments to which I shall refer were tried in Graaff-Reinet seven years ago, and were suggested by the fact that the sun's heat, if it could be economically utilized, would be an almost limitless source of mechanical power. There are certain difficulties in the way of converting the sun's radiant heat into mechanical power, but these difficulties are being overcome. The celebrated engineer Ericssen, the improver of the atmospheric engine, turned his attention to the subject, and other engineers have succeeded more or less perfectly in the construction of sun engines. There can indeed be no reasonable doubt but that in the course of a few years the mechanical difficulties of the subject will be overcome. Meanwhile it is obviously a matter of importance to us to determine what resources of mechanical power we have in the almost uninterrupted sunshine of the inland divisions of this Colony. The results arrived at are briefly as follows: (1) Every square yard of sunshine, that is to say as much sunshine as falls perpendicularly on a square yard of surface, as long as the sun is not too near the horizon, is equivalent to about one horse power, that is to say it has a heating power which, if it could be wholly converted into work, could raise 550 lbs. of matter at the rate of 1 foot a second. So that in the sun's heat which falls on a few square miles of the surface of this Colony we have a source of work greater than the whole steam power of Great Britain; and (2) The sun's heat can be collected without reflection or refraction at a temperature which will allow of a very large percentage of it being converted into work.

The definite equivalence of heat and work is one of the

most important discoveries of modern science. That there was a certain equivalence between work in the sense of force exerted through a certain space, and heat as developed in the form of temperature in a given quantity of a substance of given heat capacity was first definitely suggested by Count Rumford in consequence of the heat produced by the work required to bore out a cannon ; and the calculations he made as to the relative equivalence of heat and work are still of historical value, but his experiments were not sufficiently exact to form the basis of a scientific theory. *Carnot* was the next leading authority on this subject. His theory of the reversible engine by means of which heat could be converted into work and work reconverted into heat was an important step in advance. To Carnot is due the clear conception of the fact, that whereas a certain amount of work is capable of generating a certain amount of heat, the same amount of work is capable of transferring a much larger amount of heat from one medium to another, and that the proportion of work which can be obtained from a given amount of heat depends entirely on the temperature of the medium to which the residuum of the heat is transferred. That for example the amount of work which can be obtained from a given amount of heat communicated to the boiler of a steam engine depends on the temperature at which you can work your engine and condense your steam. That of the heat communicated to the boiler a certain portion is inevitably dissipated and that the residuum is alone capable of conversion into work, and that the proportion lost depends on what are called the absolute temperatures of the medium to which the heat is in the first instance communicated, and of the medium to which part of it is transferred, these temperatures being reckoned from—261 C.

The next step which was taken on the subject was the determination of the exact equivalent of heat and work. This we owe to Mr. Joule of Manchester who from a variety of experiments of the most diverse character came to the conclusion that an amount of work capable of raising 772 lbs. weight, 1 foot high, in the latitude of Manchester, would, if converted into heat, raise the temperature of 1 lb. of water 1° Fahr. Lastly came the investigations of Meyer and Clausius in Germany, and of Clerk Maxwell in England, the tendency

of which is to shew that what we call the heat of a body is due to molecular motion, and what is called temperature is the ability of one body to convey motion to the molecules of another body. According to the theory of these investigators the molecules of all bodies are in constant motion, the molecules of gasses moving with the greatest freedom, those of liquids less freely, and those of solids less freely still. The molecules are supposed to have several sorts of motions as free motions of translation among each other, free motions of rotation and internal vibrations. Most of the properties of gasses and most of the phenomena of heat can be thus explained with the exception however of one very important heat phenomenon, namely radiation. Thus the conduction of heat is explained by the fact that if one part of a body be heated, that is to say, if its molecules are set in more violent motion this more violent motion will gradually be communicated by repeated impacts to the molecules adjacent to them, and thus gradually disseminated over the entire mass. But the phenomenon of radiation is not to be thus explained. Heat is communicated from one body to another at a distance without the intervention as far as we know of any intermediate molecules which can communicate motions by impact. Heat can for example be communicated from one body to another at a distance without the temperature of the intervening medium being perceptibly raised, whereas if it were communicated only by molecular impacts the temperature of the medium would necessarily be as high as that of the body to which the heat was communicated. The heat of the sun for example falling on a blackened metallic surface will raise that surface to a temperature much higher than that of the atmosphere through which the heat passes. The time moreover which it takes for heat to be so transmitted being close on 200,000 miles a second, is incompatible with the theory of material impacts communicating heat. We are driven therefore to the conclusion that molecular motions which constitute heat are capable of being transmitted from one body to another at a distance through some medium almost infinitely more elastic than ordinary matter, and it is this medium which physicists call Aether. How molecular motions can be so transmitted to a distance through an intervening medium can be illustrated from

the phenomena of sound. A stretched string set in vibration will, as is well known, set vibrating a similar string of the same length and tension situated at a distance. The first string communicates its vibrations to the air which in turn communicates its vibrations to the second string. A second string however whose vibrations are not in harmony with those of the first will not be set in motion. So it is supposed that the vibrations of the sun's molecules communicate waves of motion to the aether pervading planetary space, which aether waves communicate vibrations and consequently motion to such molecules as vibrate in harmony with the aether waves. This method of communicating heat is called radiation, and the object of the experiments now to be described was to determine the amount of heat which under favourable circumstances the sun can communicate to the earth's surface, and the temperature which it was capable of raising the heated body by simple collection. It may be as well to add that the object was not to determine the temperature of the sun's rays, which although it is a phrase sometimes, used in meteorology is quite devoid of meaning. The rays of the sun are not material, and though they can communicate heat, they cannot be said to have temperature at all. The temperature to which they can raise any body on which they impinge seems to depend almost entirely on the rate of conduction of that body. All we can say is that the temperature they can impart cannot, under the most favourable circumstances, be greater than that of the sun itself.

In order to ascertain the mechanical power which can be communicated by a certain portion of the sun's heat, the following experiments were tried.

Into a vessel carefully insulated by bad conductors of heat and lined around with blackened surfaces which readily absorbed heat a given weight (1 lb.) of water was poured. This vessel was then placed in the sunlight behind a screen fixed perpendicularly to the sun's rays in which a hole of given dimensions, viz : 2 inches square, or four square inches had been cut. In this way what may be called four square inches of sunlight were allowed to pass for a certain time. This regulated beam was allowed to fall on the surface of the water in the vessel, and was absorbed partly directly by the water and partly by the blackened internal surface of the vessel which in turn

communicated its heat to the water. Another vessel of the same size and shape containing as much water and arranged in every way the same was put side by side with the first, but not in the sunshine. This was for the purpose of eliminating these changes of temperature which might be due to the atmosphere of the room. After the water of the first vessel had been exposed for a sufficient lenght of time the sun's heat was cut-off, and the temperature in the water was taken after careful stirring. Meanwhile the change of temperature if any in the second vessel was noted. The vessels were then reversed and the experiment repeated. This was done often enough to eliminate any considerable errors arising from accidental changes of temperature. The water in the two vessels was also occasionally changed to ascertain the amouut of heat necessary to warm the vessels themselves, which however was only a small fraction of that required to change the temperature of the water.

By multiplying the rise of temperature in degrees after all necessary corrections had been made by 772, and this again by 324, being the fraction that 4 square inches is of 1 square yard, and then dividing by the number of seconds during which the vessel was exposed, the mean quotent gave the number of equivalent foot pounds of work per second or the sun's power per square yard. The mean result was as follows:—

Time of exposure 55′
Rise of temperature 4° in exposed vessel (1) 11° Fahr.
Rise of temperature in second vessel (2) 4°
Estimated loss of temperature in vessel (1). 5°

Gain of temperature in exposed vessel due to sun's rays 7.5°. Whence working power of a square yard of sunlight was $\frac{7{\cdot}5 \times 772 \times 324}{60 \times 55} = 568$ ft. or a little more than 1 horse power

These experiments were made mostly in the months of September and October 1868, and between the hours of 10 a.m. and 3 p.m. There was very little difference in the heating power of the sun's rays during these hours. There was however some difference in the heating power of the sun's rays on different days, and the above result was an average of a good many experiments.

As already pointed out however the actual amount of heat which can be converted into mechanical power depends not only on the amount of heat but on the temperature at which it can be obtained. The next object was to ascertain what temperature could be obtained from direct sunshine without concentration by reflection or refraction, and by availing oneself of the peculiar power of glass to transmit the direct rays of the sun with little apparent dimunition, but to absorb rays coming from sources of lower temperature, a property to which the high temperature obtained in glass houses is due. For the purpose of finding what temperatures could be thus obtained, four sheets of plate glass 20′ by 24′ by ·25′ which were separated by means of strips of wood at their margins and placed over black cloth insulated by imperfect conductors. Spaces being left for inserting thermometers underneath and between the plates. The first experiments gave a temperature under the fourth plate of over 340° Fahr. but on repeating the experiment next day the lowest plate of glass was found to have split into small fragments. On its being removed and the experiment repeated the following temperatures were registered on different occasions:

Time.	Under 3 plates.	Under 1 plate.
Noon.	272	204
1 pm.	290	216
2 pm.	295	218

Similar experiments were at the same time played with four sheets of ordinary Belgian window glass. The results obtained were not so satisfactory though on one occasion a temperature over 300° Fahr. was registered. The result shewed that the temperature to which the sun's rays are capable of raising any body depends almost entirely on the rate at which that body conducts and radiates heat, that by cutting off conduction and radiation, a temperature can probably be attained much higher than those already registered.

VIII. *Remarks on "Clicks" with an Investigation of the Etymon of some South-African Native Geographical names.*—By C. M. Stevens, late of the Royal Observatory, Cape of Good Hope.

[Read, 28th November, 1877.]

The following memorandum has been suggested by a communication to the *Cape Monthly Magazine* for November 1877, by a correspondent signing himself S. who contributes an article on "The names of our Rivers." His paper commences with a reference to the visit of the President of our Society to Port Alfred lately, and the interest taken by His Excellency in hearing the "Bushman" prisoners converse in their own language, from whom he endeavoured to elicit, by Dr. Atherstone's aid the meanings of the names of the rivers between the Bashee on the East, and the Gamtoos, in Uitenhage, on the West. As the convicts were quite unable to give any explanation of the names, not knowing of any such words in their language, the conclusion arrived at was, that the words were either of Hottentot or Koranna derivation; and the paragraph concludes with the surmise that this will probably turn out to be the case. Before proceeding with my paper I must express my obligations to my brother, Mr. George H. Stevens, whose knowledge of the Kafir and Koranna languages, has been of the greatest assistance to me in its preparation. It is not my intention to criticize or reply in detail to the article in question, though my remarks will bear directly on some points therein set forth. In the first place I shall discuss for a few moments those peculiar sounds in native languages known as "clicks." On first hearing the languages spoken, the common impression is that the clicks are innumerable, but upon careful investigation it is found that they are really three in number and are usually represented by the letters x q c of our alphabet.

These are respectively the lateral, palatal, and dental clicks. The guttural of the Kafir language is represented by ·r (with a dot before it) there being no sound in Kafir like 'r' in other languages. Kafirs when using the 'r' sound it like 'l.' With regard to the clicks in the Amaxosa language, it would appear from the correspondent in the *Cape Monthly Magazine* that there is a belief prevalent, that they are an importation, and borrowed from the Koranna or other Hottentot tribes. The argument in support of this theory is, that the names of the rivers west of the Bashee are pronounced with clicks, and are therefore of Koranna origin. I am not prepared to give my support to this idea, as the Koranna tribes may never have been further east than the Bashee, and the country towards Natal was in all probability peopled by dense myriads of the Kafir race. I am rather in favour of the idea that the clicks are proper to both languages independently. 1st Because if we examine the name of the nation, viz.: Amaxosa, we find that Xosa is pronounced with a click (lateral) 'ama' being a prefix, the same applies to Amanqika or people of the Nqika or Gaika tribe. This name is pronounced with the palatal click. 2ndly Because there are rivers in Kafirland bearing decidedly Kafir names both in form and meaning which are pronounced with the clicks, for example, the Qonci (with palatal and dental clicks) known as the Buffalo from which King William's Town is named by the natives; the I'nciba (dental click) or Kei and so forth. 3rdly Because it is probable that a proud race of warriors like the invading Kafirs from the east would not condescend to adopt from the subdued races that which gives point and character to their language: and further, the conquerors would probably put to death all the males of the Hottentot tribes taken in battle, sparing only the women and young children, whom they would make wives and slaves of. Here I would, however, remark that as the females of a nation generally take the initiatory steps in the teaching of the language, the Hottentot women detained by the Kafirs, would inculcate some of their national ideas and words among the young children in their charge, particularly the names of rivers and places. Of course their influence would not be all powerful in this respect so that we might expect new names of different form and meaning perhaps to be given by their

lords and masters, the Kafirs. This I think has really been the case as we cited just now that there are rivers in Kafirland Proper which are undoubtedly Kafir in form and meaning near to rivers which bear names as unmistakeably Koranna. But one may be inclined to think the influence of the Koranna captive women would be comparatively small, as their numbers in the tents of the enemy were not probably large, and would not be likely to be. In this manner we may account for the mixture of Kafir and Koranna names in the Eastern of the Colony, now chiefly inhabited by Kafirs and Europeans. Having stated some reasons against the theory of the importation of clicks by the Amaxosa from the tribes expelled in their westerly invasion, I shall point out a fact which may not be generally known and which may be of some interest as bearing on the subject of the clicks x q c. *In the English language we make use of the same clicks as the native tribes of South Africa.* For instance see yon mariner approaching, mounted on a Hobson's choice self-willed and obstinate. Watch the rider and horse for a minute and hear what our sailor friend will say to the horse to induce the animal to get out of that horrid jolting trot into a decent canter. As they near you, man and horse, you will probably observe Captain John Gilpin, with a flushed face vainly endeavouring to force the steed into a canter by such expressions as these: Gee up x x x x! Gee up Dobbin! x x x x (clicks) Come! Gee up! x x x (clicks). Here we have an exact likeness of the same sound in the Amaxosa language, and it is none other than the lateral click represented by x. Again look at Maid Marian with an apron of corn in the farm yard feeding her pet fowls. How does she call them together? simply by making these sounds: q q q q q (palatal clicks) the same click as employed by our natives. Further. When anything sad has happened and we wish to express sorrow and compassion we say, Oh dear! how sad!! c c c c (dental clicks). Here then we have the third form of native click known as the dental and represented by the letter c. It will therefore be observed that the English language possesses the same clicks as the native languages of South Africa, though not used in the same way, being merely kinds of expletives whereas in South African languages they give point and character. It is quite

possible that a general investigation of other languages may discover that these same clicks are much more widely distributed than one may be aware of. Passing on from the subject of the clicks, we arrive at a more interesting point in our remarks, namely the investigation of the meaning and etymology of some of our South African native names of rivers, localities, &c. For convenience of comparison and illustration I have deemed it fit to divide South Africa roughly into three parts or circles, an eastern, a southern, and a northern. The eastern embracing the eastern end of the Colony, with the Transkeian territory of Gcaleka and Tembuland and having for its western boundary the extreme limit of Kafir influence, or of the influence of that great flood of westerly migration or invasion, which came in a north-easterly direction from the country about or beyond Natal. The second circle or division includes all the southern parts of the Colony, originally inhabited by Koranna or Hottentot tribes, now colonized and occupied by the European and Bastard races. The third division will include the central and northern parts of the Colony, where the remnants of the original inhabitants of the Colony may be met with. This division will also include the territory of Griqualand West. I have made these three rough partitions for the purpose of looking at the names, first, as influenced by a race of savage conquerors ; secondly, as they exist, unchanged by European dominion ; and lastly, as they are found in localities occupied by the remnants of the original Koranna tribes, who are so to say, comparatively uninfluenced and unsophisticated, at any rate as far as nomenclature is concerned. Starting with the eastern circle we meet such names as Kei, Bashee, Nxarune, Bira, Qonci, Irini, &c. It is a matter of difficulty to trace all these names to their probable origin, while in some it has as yet been impossible to find the meanings. We shall first take the Kei. The correspondent in the *Cape Monthly Magazine* endeavours to trace the word from the name Cnyba, taking the first three letters to base his argument upon. He therefore infers that the name is derived from the Kafir, as Cnyba, or more properly, I'nciba is the Amaxosa name for the Kei.

But the word is simply the Koranna word 'Kei,'

meaning 'great' or 'large' so that the "Kei" is merely the "Great River" or as our Dutch colonists would term it the "Groot Rivier." The name is doubtless given on account of its being the largest river in that part of the Colony. The Kafir name I'nciba does not mean large, but is an exclamation of surprise at any thing great. They will use the word I'nciba in reference to the astounding greatness of the mighty ocean, as well as apply it to a river of large size. The word Kei is pronounced sharply like Ki in Kite. Another river in these parts is the Bira—the ṙ guttural being pronounced as the letter *g* in Dutch. The name is Hottentot in origin and means the river of plenty. The same meaning attaches to the Amaxosa names for the river Keiskamma—these names are Ixesi or Kwampundu. We shall next examine the name Keiskamma. Upon first sight this name would appear to be compounded of the word Kei, which has already been explained, and the word kamma. But the letter s in the middle of the word introduces a difficulty. We will first look at the latter part of the name—*kamma*—and endeavour to discover its meaning, if we can fix its signification, a point of some difficulty will be set at rest. The word is supposed to be the Koranna name for water ; but if it is to be pronounced as written, this is not its meaning. On the other hand if the word is intended as the best representation in letters of a word which should be written Xlammi, then the supposition will hold good. For there is a word signifying 'water,' which the difficulties attending the writing of a language full of peculiarities, might lead one into representing by *kamma*. But the word '*kamma*,' pronounced as written, means 'like' or 'similar to.' Assuming then that kamma is intended for Xlammi, we may now take the first part of the name Keis as one word. The same remarks apply to this half of the name as to Xlammi. It is intended for the Koranna word Nqasa, signifying 'sweet,' so that Keiskamma, or more properly Ngasa Xlammi means "sweet water" or "nice water," similar to the name 'lekker water' applied to the stream at Newlands in the Cape Division. I have also learnt from another source that the meaning borne out by this investigation of the name is the correct one. Another river in this circle is the Qora, a Hottentot

name given on account of the clay obtained there for pipe making. Another name also of the same origin, the Cumqua, is derived from a particular kind of clayey soil used in skin dressing. The Nxarune, sometimes written as Nahoon or Naroon is a Hottentot or Koranna name, and is a kind of exclamation equivalent to. "There it is," and may have been given in the same way as I'nciba to the Kei, though I must confess that the reason for the bestowal of such a name is not at first sight so very apparent. The explanation may be considered as having the appearance of being travel worn and dusty through having been "fetched so far," but I venture it for what it is worth, on its own merits. Another well known river name is the Gonubie, properly Qunube, a Kafir word meaning "blackberry," given probably from the wild fruits of this kind found on or near its banks.

The Qonci and Irini are Amaxosa names for the Buffalo and Kowie (T'cowi) Rivers, and King William's Town and Graham's Town, are called by the same names from these rivers flowing near them. We therefore see then, that in this first or eastern circle there are many names of purely Hottentot origin, which were undoubtedly given by the first owners of the soil. As these were displaced by the eastern invaders, the names probably underwent modifications, in some instances, to suit the Kafir mind ; in others were not changed at all, while in others again they may have been changed entirely by the conquerors, notwithstanding the influence of the captives which has before been referred to. In this wise we can easily account for the mixture of Hottentot and Kafir names in the East, the Kafir names predominating in the direction from which they came, viz. :—eastwards towards Natal, where we meet with such names as the Umzimvubu, the Umzinkulu, and Tugela. The Hottentot or Koranna names begin more towards the west, the first strongly marked one being the Kei or Great River, the present boundary of the Colony proper. We will now pass out of this eastern division, and examine a few names in the second circle. Coming down the coast from the east we meet with a river called the Gamtoos of undoubtedly Koranna origin. It flows through the division of Uitenhage, and we shall adopt it as the rough boundary between the first and second

divisions in our scheme. The name of this and other rivers pronounced as they are written, would, undoubtedly not have been understood by the convicts addressed by H. E. at Port Alfred as the slightest difference in the pronunciation, which would not be detected by our ears, would lead to a totally different meaning or mystify the Hottentot mind beyond all hopes of arriving at any satisfactory understanding. I must here remark, by way of preparing the members of this Society for the reception of any further explanations I may be able to give, that given as the native is to similes and comparisons, he makes them in a manner that would at the mildest, be pungent to the educated European sensibilities. The names they give may be strictly poetical yet not be in accord with the ideas of the beautiful as cultivated by the white race. For instance they will invest a natural phenomenon with personality. Rain, a natural phenomenon, they will liken to a man and call the rain Toos. Here then we have a part of Gamtoos, the river we are endeavouring to investigate the meaning of. But we have only half of the word, in the remaining part Gam, in itself a complete word, we shall find the key to the difficulty. Gam means spout, duct, cock or tap (or to be in exact accord with the low native idiom, means *membrumvirile*). Putting the two parts together we get Gamtoos, meaning simply and clearly rain spout, rain cock, or rain tap. This name was derived in all probability from the amount of water flowing down after rains, or at any rate from observations of a more or less imperfect kind made on the spot by the original Koranna inhabitants. The next name in this division for examination is the Gouritz flowing into the sea to the west of Mossel Bay. This is another pure and unaltered Koranna word and means Diarrhœa River, from the habit it has of coming down with a mighty rush after rain, muddy and filthy, bearing trees, bushes and debris in its downward rush. This seems to me to be the explanation of the native mind in bestowing such names. The first part of the word comes from the name Gouph which we shall examine presently, and *ritz* is probably a word imitative of the noise of something rushing down a narrow channel with sudden force. In this circle or division there is a tributary river known as the Gamkamma. The Gam in this instance is not the same word that we

met within Gamtoos, but is derived from the Koranna word Ṙammi, a lion. Kamma in this instance is intended for Xlammi, the name for water, so that Gamkamma or Ṙammi Xlammi means Lion Water or Lion River.

As the original tribes were forced westwards by the incoming Kafir flood from the east, they were met after a while by the settlements of whites along the southern and western shores of the country. As a natural consequence they were forced away from the seaboard and driven inland, leaving behind them traces of their occupation in the names of the rivers, &c., besides some figures drawn on stones and other curios found in the caves near the coast. After leaving the more pleasant coast line they were obliged to cross a tract of country which was very dry and parched up, probably at the time of their exodus. Being actuated by their uncontrolled feelings, they named it with a name of strongest disgust, they called it Gouph, by which it is known to this day. The exact meaning of the word is something more emphatic than dry or sterile, it is synonymous with filth, dung, &c., &c., A young man I have met from the Karoo country told me with reverential seriousness of countenance that Gouph meant Land of Canaan, or the Pleasant Land! 'Indeed'! was the only reply. They named the other part of the country Kaloo or as we write it Karoo on account of its drought. Kaloo or Karoo means dry and hard. We have now travelled into the third circle of our proposed division of the country, and here I shall only be able to give two or three names. In this large area we have the purest remnants of the Koranna or Hottentot races. Having noticed the names Gouph and Karoo which belong to this division as well, I shall just draw attention to the native names of the great natural boundary of our Colony on the north, viz.: the Orange River and its two main affluents. These affluents are called the T'cy Gqariep, a name signifying Yellow River, from the colour of its water. The other is named the C'nu Gqariep, or Black River, for a like reason. When these streams are merged into the Great Orange River, the native names change and become Kei Gqariep or Great River. Here in the word Kei we have the same word in form and meaning that we met with when we started on our investigations. We have often, in reading

of the Diamond Fields, met with the curious name Gong Gong. This name is given by the natives to a part of the Vaal River near Cawood's Hope diggings, for the following reason. At this spot are some insignificant falls in the river, about 12 feet or thereabouts. When the water is very low some of the rocks are exposed and form a small island in the river. One of the rocks has a hole in it, and as the water goes tumbling through, it does so with a noise which the natives describe by the name *Gqum gqum*. Hence this peculiar name of Gong Gong. Near this locality is a place named Keiskamma, or rather a name so pronounced and spelt, which is the same in form apparently, as the name of the river met with in the eastern part of the Colony and examined in the earlier part of this paper. But the name has no affinity either in etymology or meaning with the river name, the similarity of spelling and pronunciation being entirely due to the loose manner in which writers spell native names.

As it is very natural and general to name localities, mountains, rivers, &c. from any strongly marked natural features or characteristics they may possess, in such a comparatively tame and uninteresting country as the Cape Diamond Fields, we can easily conceive the difficulties that the native mind would meet with in endeavouring to procure suitable appellations for spots that were worthy of having specific names. We can conceive that a tree or a small rock would be sufficient to guide them in their choice, and in this manner we shall have no difficulty in finding the reason and meaning of such a name as Keiskamma. Near Cawood's Hope, at a bend in the Vaal River (T'cy gqariep) there grew not very long since, camel thorn trees eight in number. As these trees were a remarkable feature in the land scape the natives called the spot *Xlisi Xlanna* or "eight camel thorns" from the Koranna words *Xlisi*, meaning 'eight' and *Xlanna*, signifying 'camel thorn tree.' At the time my brother visited the spot there were only two of the trees remaining, and now probably the ruthless hand of the invading digger has cleared away the last vestige of the trees that gave the name to the locality.

In a very short time, after the death of the "oldest inhabitant" tradition will have died out, and it will be a vain task to endeavour to find out the reason of such a

name being bestowed, from any of the natives who may chance to live in the vicinity. In this manner we can account for the difficulty of arriving at the meanings of certain native names. The circumstances giving rise to the names have passed away, tradition is dumb, imagination or something else must fill up the blank. It will have been observed that the terms Koranna and Hottentot have been used indiscriminately, the intention was to employ these names as belonging to a family of languages opposed to and in contrast with the Kafir, in investigating the names of rivers and places in Southern Africa. The paper is not intended as an investigation of languages, nor is it perfect or complete even as far it goes. I may therefore express the hope that others having the time, opportunity, and means may be induced to follow up and complete what has here been begun. The subject is of great interest and cannot fail to repay an ardent worker. The native races are fast losing their individuality of existence, contact with the more civilized races tends to the destruction of the particular type though not necessarily to the destruction of the race. They are simply absorbed into other channels, develop into types which are neither European nor Hottentot ; but a compromise between the two.

C. M. STEVENS.

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OF THE

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FOR 1877-78.

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THE TRANSACTIONS

OF THE

SOUTH AFRICAN

PHILOSOPHICAL SOCIETY.

No. 2058
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1877-78.

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J. C. JUTA,
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CAPE TOWN :
SAUL SOLOMON AND CO.,
PRINTERS.

PROCEEDINGS

OF THE

SOUTH-AFRICAN PHILOSOPHICAL SOCIETY.

[*From the first Ordinary Monthly Meeting of the Society held on Wednesday 26th September, 1877, to the end of the year* 1878.]

Wednesday, 26th September, 1878.

Ordinary Monthly Meeting.
Dr. Ebden called to the Chair.
Twenty-eight Members and two Visitors present.
Papers read:—

(1). "Remarks on *Roridula dentata*, one of the Insectivorous Plants, illustrated by specimens," by Dr. Shaw.

(2). "On the age of the Volcanic Throats of the Upper Karoo Formations of South Africa," by Dr. Shaw.

(3). "On the movements of Sea Sand and Bar Harbours," by Mr. H. W. Piers.

Mr. Trimen exhibited two specimens of the Colorado Beetle.

Wednesday, 31st October, 1877.

Ordinary Monthly Meeting.
H. Bolus, Esq., in the Chair.
Twenty-eight Members and four Visitors present.
Thomas Bain, Esq.
William Prosser, Esq., F.G.S.
Herules Tennant, Esq.

Dr. Woolfryes, P.M.O., Army Medical Staff, were elected Ordinary Members, and;
David Arnot, Esq , F.L.S., F.G.S., of Eskdale, Albania, Griqualand West;
Henry Exton, Esq., M.D., Curator of the Museum, Bloemefontein, Orange Free State;
Emil Holub, Esq., M.D., of Kimberley, Griqualand West;
Peter MacOwan, Esq., B.A., of Gill College, Somerset East;
John Joachim Monteiro, Esq., F.G.S., of Lorenço Marques, Delagoa Bay;
Were elected corresponding members.

Paper read:—

"On the Devonian and Ash Beds of the Karroo and Gouph" by W. Prosser, F.G.S.

Friday, 2nd November, 1877.

Special Meeting in welcome of Mr. H. M. Stanley, held in the Commercial Exchange.

The Hon. R. Southey, C.M.G., M.L.A., in the Chair.

Mr. Stanley addressed the meeting on the subject of his recent journey, which extended from Zanzibar to the mouth of the Congo, and included the circumnavigation of Lakes Victoria Nyanza and Tanganyika; the discovery of a Lake termed by the explorer the Alexandria Nyanza; and the descent of the Lualaba, proving the identity of that river with the Congo.

Wednesday, 28th November, 1877.

Ordinary Monthly Meeting.
Mr. Bright in the Chair.
Seventeen Members and two Visitors present.

The following gentlemen were elected Members:—

Henry de Smidt, Esq.,
William de Smidt, jun. Esq.,
W. A. Lippert, Esq.,
James McGibbon, Esq.,
G. Myburgh, Esq.,
J. C. Wessels, Esq.,

as Ordinary Members.

James Henry Bowker, Esq., F.G.S., F.R.G.S., Governor's Agent in Basutoland.
The Right Rev. Henry Collaway, D.D., Bishop of St. John's Kafirland.
The Rev. H. Tindall, of Leliefontein, Namaqualand.

as Corresponding Members.

Papers read:—

(1). "Note on the Colorado Beetle (Chrysomela decemlineala," by Mr. Trimen.
(2). "On a Specimen of the so-called Bonnet of the Southern Right Whale," by Mr. Trimen.
(3). "On the Heat of the Sun in South Africa," by Mr. Guthrie.
(4). "Remarks on Clicks, with an investigation of the Etymon of some South African Native Geographical Names," by Mr. Stevens.

Wednesday, 30th January, 1878.

Ordinary Monthly Meeting.
Mr. Bolus in the Chair.
Eleven Members and one Visitor present.

The following gentlemen were elected members:—

Edward John Dunn, Esq., F.G.S., Colonial Geologist.,
H. P. du Preez, Esq.,
H. le Schuncke, Esq.,

as Ordinary Members.

Sydney Stent, Esq., C.E. of the Public Works Department,

as Corresponding Member.

A map of Bailie's route from Barkly to Amandebele, presented by His Excellency Sir Bartle Frere, was exhibited.

Communications from the Royal Society of New South Wales were acknowledged.

Dr. Shaw exhibited a specimen of Erica Glandulosa as being probably Insectiverous.

The following papers were read:—

(1). "Stray notes on the Geology of Fort Beaufort District," by Mr. H. W. Piers.
(2). "On the Meteorology of the Sea Side," by Mr. Stevens.
(3). "On the Limestones of some parts of the Cape Colony," by Mr. W. Prosser.
(4). "On the Determination of Distance by Observations of the Velocity of Sound," by Mr. Stevens.

Wednesday, 27th February, 1878.

Ordinary Monthly Meeting.
Dr. Shaw in the Chair.
Thirteen Members and two Visitors present.
Mr. John Matson, of Zonnebloem, was elected Ordinary Member.
Mr. Trimen exhibited a specimen of Hawkmoth. *Macroglopa hirundo,* Gerstäcker, taken by him at King William's Town.

Paper read:—

"On the Granite and Gneiss of the Colony," by Mr. Prosser.

Wednesday, 27th March, 1878.

Ordinary Monthly Meeting.
The Hon. J. X. Merriman in the Chair.
Forty-two Members and sixteen Visitors present.

Paper read:—

"On a proposed Overland African Telegraph," by Mr. Sivewright, M.A.

Wednesday, 24th April, 1878.

Mr. Bright in the Chair.
Twenty-four Members and five Visitors present

Members elected:—

Mr. James Sivewright, M.A.
Mr. James William Bertram,

as Ordinary Members.

Paper read:—

"On the Coal Fields of the Colony," by Mr. W. Prosser.

Wednesday, 29th May, 1878.

Ordinary Monthly Meeting.
Dr. Shaw in the Chair.
Sixteen Members and ten Visitors present.
The Chairman announced that the question as to the admissibility of ladies to the meetings of the Society having been brought before the Council, it had been decided that ladies were admissable as Visitors at meetings under Section II. No. 3 of the By-Laws of the Society.

Members elected :—

Mr. Branford, Colonial Veterinary Surgeon,
Mr. Ludwig Wiener, of Mowbray,

as Ordinary Members.
Donations of books from His Excellency Sir Bartle Frere were acknowledged.
A resolution was moved by Mr. Prosser, and seconded by the Rev. D. Smith :—That it is desirable to form a section of the South African Philosophical Society, to be entitled the Ethnological Section, which, while paying attention to Ethnology generally, will devote itself specially to the work of the Preservation of Bushmen drawings and other Bushmen remains."
Mr. Trimen exhibited a specimen of a large ground spider of the genus Mygale, from Mr. James Lycett of Worcester.
Mr. Dunn exhibited a Chalcedony Crystal containing a drop of clear liquid.

Papers read :—

"On Dr. Cohen's Observations on the Geology and Mineralogy of Table Mountain Valley," by Dr. Shaw.
"On the Peculiar Colours of Animals in relation to Habits of Life, by Mrs. Barber. (Read in part by Mr. Bolus)."

Wednesday, 26th June, 1878.

Ordinary Monthly Meeting.
Mr. Guthrie in the Chair.
Fifteen Members and five Visitors present.

Members elected:—

Mr. James Whitton, of Cape Town, as Ordinary Member.

Mrs. Barber, of Kimberley, Griqualand West, as Corresponding Member.

Papers read:—

(1). "On the Peculiar Colours of Animals in Relation to Habits of Life," by Mrs. Barber.

(2). "On Rainfall in South Africa," by J. Gamble, M.A., Colonial Hydraulic Engineer.

Friday, 26th July, 1878.

Annual General Meeting at the Mutual Hall at 2 p.m.

Mr. Gamble in the Chair.

The General Secretary, Mr. R. Trimen, and the Treasurer, Mr. H. Bolus, read the General and Financial Reports as follows:—

The Council has much pleasure in submitting to the Annual General Meeting the following Report on the Society's progress and operations during the first twelve months of its existence:

The Society was declared constituted on the 22nd June, 1877, when thirty-nine gentlemen subscribed their intention of joining it. The list was kept open for signature until the 30th June, by which date the number of Members had increased to seventy-eight. The discussion of the Rules of the Society, submitted by a Committee appointed to draft them, occupied four Meetings; and the Rules were finally adopted on the 16th July. The ballot for the election of the President and Council followed on July 23rd, and the first ordinary monthly meeting was held on September 26th. In the interval the Council had carefully framed the By-laws necessary for the orderly management of the affairs of the Society, contemplated by the 11th Rule, and at the subsequent monthly meeting in October, printed copies of the Rules and By-laws were issued to Members.

Nine ordinary meetings and one special meeting of the Society have been held; the latter being in welcome of Mr. H. M. Stanley, the explorer of Central Africa, who addressed a large audience of the Members and their friends on the subject of his recent travels. Apart from

Mr. Stanley's lecture, eighteen papers have been read before the Society, eight of which related to Geology, four to Biology, three to Meteorology, and the remaining three to Physics, Philology, and Telegraphy, respectively. Eight of these papers have been printed in the first part of the Society's transactions, issued during last month, and the Council feels justified in congratulating the Society on the character of these its earliest efforts in "promoting original research," the watchword of our Association. The Council views in these communications an earnest of further and wider endeavour in the cause of science, and would urge upon all Members of the Society the duty of contributing to the general work of observation and record.

During the year nineteen Ordinary and ten Corresponding Members have been elected. This addition to our ranks would raise the total number to 107 ; but from this four must be deducted, as we have lost by resignation one Ordinary Member, and have further to deplore the death of two Ordinary Members and one Corresponding Member, viz : Mr. Kunhardt and Mr. Van de Sandt de Villiers, and Mr. Monteiro. The loss of the latter is no ordinary one, Mr. Monteiro having distinguished himself in Western Africa as an excellent observer and naturalist, and possessing, in the position which he had recently taken at Delagoa Bay, exceptional facilities for carrying on his researches in a field very little known. The present numerical strength of the Society is now 103, and the Council expresses the confident hope that this number may be substantially increased during the ensuing year.

The Society is much indebted to the University authorities for according the free use of its convenient rooms for the Society's Meetings. Endeavours have been made to secure suitable premises for the Society's use, but some difficulty has been experienced in finding quarters in a central situation at a rent not incommensurate with our resources. It is hoped, however, that arrangements for properly locating the Society will very shortly be completed.

By order of the Council,

R. TRIMEN,
General Secretary.

26th July, 1878.

DR. *The Treasurer in Account with*

	£	s.	d.
To Subscriptions from 86 Members from 1st July, 1877, to 1st July, 1878, at £2 each	172	0	0
„ Subscriptions from 3 Members from 31st December, 1877, to 31st December, 1878	6	0	0
„ Subscriptions from 2 Members from 31st March, 1878, to 31st March, 1879 ...	4	0	0
	182	0	0

Audited and found correct:

C. R. EATON,
L. MARQUARD, } *Auditors.*

the South African Philosophical Society. CR.

		£	s.	d.	£	s.	d.
By Expenses of Meetings and Collecting Subscriptions:—							
Aug. 27.	Paid W. Cosskey ...	3	0	0			
Oct. 1.	„ Stamps ...	1	0	0			
Nov. 6.	„ W. Cosskey ...	4	2	0			
1878							
Feb. 1.	„ Do. ...	1	13	6			
April 4.	„ Do. ...	1	1	0			
June 3.	„ Do. ...	1	5	0			
„ 30.	„ Keeve lighting	0	10	0			
					12	11	6
By Expenses Stanley's lecture :—							
Nov. 16.	Paid W. Ball ...	1	5	0			
April 5.	„ O'Callaghan ...	6	19	0			
June 30.	„ Police	0	6	0			
					8	10	0
By Advertising, Printing and Stationery :—							
Oct. 12.	Paid W. Foster & Co.	5	14	6			
Dec. 21.	„ Do. ...	12	7	6			
May 1.	„ Cape Times ...	1	0	0			
„ 29.	„ S. Solomon & Co.	7	11	6			
June.	„ Envelopes ...	0	3	0			
„	„ Cape Times ...	0	19	0			
„	„ Foster & Co. ...	0	14	6			
„	„ Barry, Arnold & Co.	0	13	6			
„	„ Cheque book ...	0	2	2			
					29	5	8
By Furniture :—							
Nov. 16.	Paid for Deed box ...	1	10	0			
1878.							
Jan. 28.	„ „ Ballot box	1	10	0			
					3	0	0
June 30.	By Balance in the hands of the Standard Bank, as per Pass Book	...			128	12	10
					182	0	0

HARRY BOLUS, *Treasurer.*

Cape Town, July 1, 1878.

The President and Members of the Council for the ensuing year were then elected as follows:—

His Excellency the Right Honourable Sir Bartle Frere, President, and

Messrs. H. Bolus,
J. G. Gamble,
Dr. Shaw,
R. Trimen,
H. E. R. Bright,
Dr. D. Hahn,
F. Guthrie,
J. X. Merriman,
J. Fforde,
J. Sivewright.

At 3 p.m. the President delivered the annual address on the subject of the Native Races of South Africa:—

Ladies and gentlemen and members of the South African Philosophical Society,—The report which the secretary has just read precludes the necessity for any prolonged remarks on the working of the society during the past year. It shows, I think, that we need neither fear any want of field for the exertions of such a society, not of adequate support from our fellow citizens in South Africa. The rules of the society, as you are aware, require that the president should either himself deliver an annual address or depute some one else to do so. In compliance with this rule, I propose to-day to ask you to take a general view of the field of work open to the society in inquiries regarding the native races of South Africa, their probable future, and their relations to the great body of northern European races, which, during the last 400 years, have established themselves in the southern part of the continent. As a necessary preliminary, let us briefly enumerate the indigenous races found here when Europeans first appeared on these shores. I will not attempt any accurate ethnological classification, for that would be to anticipate the result of inquiries yet to be made. I will content myself with such a popular classification as any observant traveller would make in passing through the country. As an aid to his further inquiries he would probably class them by colour. The

yellow races popularly known as Hottentots and Bastards and descended from them, Gonaquas, Kokoikhoin, Korannas, Griquas, Namaquas, Bushmen, Bosjesmen, Souquas, or Obiquas. Black races of pure Negroes woolly haired Berg Damaras. Brown races or Bantu tribes, popularly known as Kafirs of various clans, including Zulus, Amaxosas, Galekas, Gaikas, T'Slambies, Tembus, Fingoes, Bomvanas, Pondos, Amatabele, Amatonga, Amaswazi, Bechuanas, Basutos, Baralongs, Batlapins. Bmangwato, Bangwaketsi, Papedi, Makalalla, Makololo, Damaras, Herero. Remember, I do not offer this as a scientific or complete enumeration, but simply as a convenient popular classification, such as may help anyone who has not previously studied the subject, to follow me in laying before you the various branches of inquiry, any one of which any member of the society may usefully follow, if he wishes to add to or systematise our present fragmentary and unsystematic knowledge of native races. And I shall use, in referring to the tribes, the colloquial and popular names, even when not strictly accurate, rather than the less well-known, but more correct nomenclature of the professed ethnologist. Let us, for example, take the case of anyone who wishes to examine and learn for himself, and to contribute his quota to our knowledge of the native races. There is no race of which he will not from time to time meet specimens here in Cape Town, whilst up the country wherever he goes, he will find large sections of the population composed of one or other of the native tribes, "in situ," as the geologist would say; and often so largely preponderating over the colonists of European descent as to form in reality the great mass of the people amongst whom he lives. His first question will naturally be, what do the dark-skinned people of purely African descent with whom he meets call themselves? What are they called by their neighbours? The *nomenclature* of the native races will be his first point of inquiry. And he will find it not the easiest point on which to arrive at decisive and satisfactory results. There is naturally great inaccuracy and a tendency to indiscriminate generalization among all who do not regard the question from a scientific point of view. Every yellow skinned native is a Hottentot or Bastard;

every black or brown man is a Negro or Kafir. Again, the people themselves are apt to mislead enquiry by giving erroneous accounts of their own origin and tribal descent. In the west many affect to be of European origin in more than the Christian and surnames which they bear. In the eastern and frontier districts the smaller and broken tribes are apt to claim affinity with the powerful and well known. When the inquirer has cleared up the obscurities of nomenclature, he will find fresh and interesting subjects of investigation in defining the geographical distribution of the people he is studying. Even as regards the present distribution of tribes, he will find many obscurities and some of those surprises which are among the pleasures of systematic, scientific research. He will find it necessary to apply the rigid tests of methodical investigation to the most accepted facts recorded by the most trustworthy and well-informed writers. Does he wish to investigate the history and characteristics of the Hottentot tribes, he will be checked by the assurance that a Hottentot of pure race is hardly now to be found. He will probably find reason as he inquires further, to doubt the correctness of this conclusion; but he will find much evidence that the race, in former and not very remote days, occupied a far wider area than it has done since Europeans settled in South Africa. Here as elsewhere where scanty unwritten traditions, or the notices of early travellers are the only materials of history, much may be learnt from a careful collection and study of the native names of rivers, mountains, and other geographical features of the country. It is thus that the limits of Hottentot occupation eastwards, at the time of the first Kafir invasions have been approximately fixed. For this species of evidence, an old shepherd or hunter may be a more valuable witness than the most educated or intelligent chief, but care and discrimination are needed in the collection of this as of every other species of evidence. I have known an admirable theory of former tribal occupation based on the derivation of names of rivers and hills upset by the discovery that the herdsman who gave the names was himself a captive from a distant tribe, and in his solitary servitude had amused himself with re-naming for himself with some reference to their natural features

the hills and streams among which his lot was cast. The collection of such data is in itself a most interesting occupation, involving as it does a record of fugitive traditions and folklore, which are fast disappearing as education and European civilization spread. Every one who has patience to hear and record the stories of the old crone, or of the Nestor of the herdsman's kraal, may in this way become instrumental in preserving invaluable data for the ethnologist or historian. The names of remarkable and well-known mountains or rivers where the tribe once lived, or of long forgotten tribal migrations, will often survive as embellishments of a fireside tale, long after all other trace of the fact has disappeared. But it must be remembered that the qualifications of a good hearer, and accurate or intelligent recorder of fireside stories are, at least, as rare and valuable as those which constitute a good storyteller. Patience, good temper, and some measure of sympathy, are of course essential, but much discrimination, judgment, and knowledge of similar folklore of other countries and races are necessary to sift what is heard, and to separate the genuine national tradition or superstition from the storyteller's borrowed embellishments or extempore additions. Above all, a knowledge of the storyteller's own language or dialect is essential to the perfect collector of oral traditions; and this brings us to the most important branch in all such inquiries; language is in some respects the most permanent, in others the most changeable and evanescent of all characteristics of race. Some of the languages of South Africa, such as Kafir or Bechuana, have already attracted so much attention from scholars, that there would seem to be nothing left to gather for any but professed philologists. Vocabularies, dictionaries, and grammars, and translations of such books as the Holy Scriptures, have seemingly done all and more than an ordinary intelligent observer could attempt, to secure what is useful to literature or science. Yet there remain everywhere gleanings which will repay the careful gatherer, and which, in a few years, may come to be regarded as of inestimable value. Let us remember that some of these languages seem destined to speedy and inevitable extinction, whilst others seem likely to survive, much changed, perhaps, and enlarged, but

substantially the same in genius and in much of outward form. Whilst nothing is likely to arrest the extinction of the Hottentot or Bushman's language as a living tongue, the language of the Kafir or Bechuana promises to survive for ages, altered, perhaps, and greatly improved, but substantially the same; and to continue to be the language in which millions think and speak. Again, let us remember that the study of these languages has a twofold use—the one social, connected with the arts and uses of common everyday life—the other scientific. It is in the power of almost anyone who takes the trouble to promote either the one or the other object of study, and there is ample scope for his labours in either field of work. Let us take, for instance, the subject of an uniform alphabet. This is as necessary to the compiler of a cheap vocabulary for the merchants, soldiers, or traveller's use as for the translator of the Holy Scriptures or the professed philologist, and it is a work not yet perfectly accomplished in the best known of our South African languages. We hear much of the inconvenience of keeping up so many languages and dialects, as a reason for discouraging their study. Doubtless there would be practical convenience if all men were of one speech, but let us be warned by despotic Governments in various ages and various climes that the extinction of a national tongue is not to be accomplished by force. Experience everywhere teaches us that it does not rest with Governments, or with philologists, or philanthropists, to do much either to abolish or preserve a separate tongue—to decide whether a dialect shall live or become one of the dead languages. Other agencies, more subtle and potent than Government authority, decide the question; but there can be, in my opinion, little doubt that whether a language is doomed to destruction or preservation, either tendency is promoted by its study among men speaking a yet more vigorous tongue, and belonging to a dominant race, who will in return teach their language to the less numerous or weaker race. For everything connected with the languages of the native races I might say for everything connected with the native races in all the relations we are now considering, students in and near Cape Town have an invaluable auxiliary in the Grey library. A truly royal gift, such as enlightened sovereigns

in other countries bestow on their country or bequeath as their best memorials. This valuable library has, since it was given to the country been enriched by the recorded labours of that lamented scholar who devoted his life to rescue from oblivion the fast perishing language of literature of the Bushman race. I feel certain that every member of this society will have rejoiced to hear the assurance given by ministers lately in Parliament that they will not permit another session to pass without making legislative provision for the safe custody and extended use this noble gift. Among the first offshoots from the South African Philosophical Society will, I hope, be an active section devoted to the languages of ethnology, history, and characteristics—intellectual as well as physical—of the native African races. Such a section your society could not open its share of our transactions with a better preface than by publishing a summary of Dr. Bleek's literary labours, and republishing all his reports to the Government department of native affairs between 1873 and the time of his death. This would be a fitting prelude to a continuation of his labours. No better nor more complete system of working could be desired than that which he followed to note down, classify, and translate the fugitive traditions and folklore of those children of the wilderness. The headings under which he grouped his collections were, as you may be aware, (A) mythology, fables, legend, and poetry, under which heading he had the subdivisions of (i) The Mantis, with the vast collections of curious and often graceful legends and myths connected with the Mantis—his wife, the Hyrax or rock rabbit. Their adopted daughter, the porcupine, whose father, the all-devouring monster, with whom she may not live for fear of being eaten. The pet eland which the Mantis makes out of a stolen shoe hide, and feeds with honey. The Ichneuman, the miercats or juricats from whom the Mantis escapes by creating a great darkness. All these and many other animals speaking a language of their own, with each a variety of clicks unknown to the Bushman's own tongue. The moon also created out of a shoe thrown up into the sky. The *ignis fatuus* personified by a being whose eyes are in its feet. The Mantis adventures with the lion, the cat, the lynx, and the elephant. The great

water tortoise who deceived the men of a race more ancient than the Bushman. The magic birds and monsters, last and most curious of all the transformations of the Mantis into the devil when the Bushman comes to tell his mythological legends to the children of his Dutch or English master. (ii.) Sun and moon, as objects of siderial worship, an honour apparently never accorded to the Bushman's legendary favourite the Mantis. The lion, originally a man with luminous arms thrown up in the sky, when sleeping by children of the ancient pre-Bushman race. The moon, which waxes and wanes as stabbed and cut by the sun. The moons connection with the origin of death. The message sent to mankind by the hare, who reverses the message of the renewal of life into a message of death, the anger of the moon when laughed at, &c. (iii.) The most picturesque legends regarding the stars, whose constellations are named after beasts and reptiles, and their origin often attributed to children of the pre-Bushman race. The Medusa-like power which girls of this race professed to fix by a glance for ever in the sky those on whom they looked. The legends of Jupiter as the "Dawn's Heart" and the "Dawns heart's child." The beasts and birds which they acted, and from whom are heard discourses on social duties, advice regarding suitable marriages and the like. (iv.) Animal fables, many of them quite equal to the ancient myths and allegories of the Greeks—the Hindoos and Scandinavians—some of them with curious references to a renewed life or the restoration to life of the dead. (v.) Legends, many of them apparently told with great epic power, in which the rain and the wind, as well as animals and people of the pre-Bushman race, take part. (vi.) Poetry, including songs of every kind of animal in the peculiar dialect proper to the hero of the tale. Prayers to sun, moon, and stars, the "Return Home," the "Mother's Last Illness." Under the second heading B. History (natural and personal) were the subdivisions. Hunting adventures, personal histories, including journeys to Cape Town and life at the Breakwater Convict Station. Dreams. Sketches of life at Cape Town. Customs and superstitions on rainmaking. Medicines and death. A description of the place to which dead Bushmen depart after death, and many tales connected with death, the wife's and the mother's

faithful nature. All these under various heads as (vii.) Animals and their habits, adventures with them, and hunting. (viii.) Personal history. (ix.) Customs and superstitions. (x.) Genealogies, words and sentences. Into one or other of the headings of this complete and well-arranged system, the student of native folk-lore, will have no difficulty in classifying the fruits of the most extended inquiry, and completing the work so well commenced by Dr. Bleek. Let not those who have the opportunity be discouraged from such inquiries by the extent and thoroughness of the work already done. What Dr. Bleek wrote in 1875 (second report, dated Mowbray, February, 1875), is still true when he said that "the richness" of Bushman literature "had been a surprise" to him. He remarked on the good fortune of those so situated "as to be able to collect even thus much of the world of mind of a dying out, and in many ways an exceptionally primitive nation:" adding "the thought cannot but strike us that there are also several other aboriginal nations in South Africa, which although not probably doomed to such quick extinction as the Bushmen, yet cannot, under the now fast increasing sway of our civilization, but lose rapidly much of that originality in their life and ideas, which is of such great scientific importance." He points out that the Kafir and Hottentot races probably possess a traditionary literature of equal importance to that of the Bushmen, that it is of firstrate scientific importance to a correct knowledge of their languages, and of the original workings of the native mind, and of their spiritual state before the advent of Christian missionaries. He points out the injustice done to those great movers and enlighteners of the savage mind by the absence of record of what they overthrew, and as Sir George Grey said:—"Of what were the real nature and greatness of the dangers and difficulties against which they were forced to contend" that "while what they accomplished remains visible the greatest and most difficult part of their work, what they abolished, is now lost to our knowledge and view." Hence men are too apt to undervalue their labours, and losing sight of what the world was without Christianity altogether, will misconceive the advantages that Christianity has secured to the human race. No one in South Africa can plead want of opportunities

equal or greater than those which Dr. Bleek possessed for carrying on this work, when he had only a few Bushman convicts to learn from. Many of us, without going far from our homes in this neighbourhood, might find large communities of whose folk-lore we know but little, and in all the remote provinces there are still untouched mines of such knowledge of the greatest value. Dr. Bleek points out that it is only in Natal that any large collection of native folk-lore has been made by Bishop Calloway. Among frontier Kafirs he mentions the collections of two natives, both now dead, Wm. Rekale Kaye, and the Rev. Tyo Sago, to which, I hope, we may now add the collections made by Mr. Theal. "Of the rich treasures of Satshuana folk-lore we obtain," he says, "some glimpses in Casalis; but little in this language has as yet been accurately taken down from the lips of the natives." He points out that the collections in Hottentot and Damara of the Revs. Messrs. J. G. Kronlein and J. Rath, valuable as they are, "yet comprise only a small portion of what could be given in these languages." He shows how comparatively easy the task now is—how impossible it will be in a few years to attempt it—to preserve that which is most characteristic of the humanity of the aboriginal races, and therefore, most valuable, their mind, their thoughts, their ideas. He asks, "What would not the coming generations of colonists give if they could have opportunities such as we have for penetrating into the minds of the original inhabitants of this country." We may estimate it by reflecting what we would now give for collections like Dr. Bleek's, made by some contemporary of Alfred, or even of our Plantaganet kings, among the wild inhabitants of Wales or Cornwall—of the highlands and islands of Scotland, or on the banks of the Shannon or Blackwater. There is no one in any of our frontier districts, or even within reach of any of the starving hordes of Kafirs lately dispersed through our western provinces, who cannot help in this work—in preventing - to use Dr. Bleek's words—"the mental life of the aborigines in its uninfluenced primitiveness from becoming quite effaced without our making an effort to preserve an image of it, fixed in the truest manner in their own words." Let us note the practical importance in all enquiries regarding customs of inquiring the date when any custom was introduced, and

whether it is universal or wide-spread and invariable. This is of moment as regards the significance of the customs themselves, still more as regards the inflexibility of the custom. For instance, we find within recent times many changes in dress and decoration. I have been assured on the frontier that the practice of the Kafirs smearing themselves with red clay is comparatively a modern custom, and the practice of wearing sheepskins and karosses has been superseded latterly by blankets. At first only red blankets would be worn, but now they use white and other coloured blankets. All these things show that the people, unchangeable as they may be in some of their customs, are yet not exempt from the mundane liability to change in everything. It will be found on investigation that most of the great races of Kafirs have been in a state of perpetual movement, and if we trace the tribes between here and the Red sea, we shall find a chain of natives quite distinct apparently from the purely negro tribes on the other side, and bearing the permanent characteristics of the brown races on our border. I should be sorry to attempt to found any theory upon resemblances which after all may be superficial, but it shows us the importance of looking to the history of the migration of these people if we would discover their real origin. As regards history, it is to be feared that little remains which can be learnt from existing tradition, and it is not easy to say what may be gathered from other sources. There is, for instance, the well-ascertained fact that the Kafir races are recent comers into this part of South Africa. A wide range of enquiry is opened to those who will devote themselves to reserve all that can yet be learnt of the arts of the aboriginal races, and especially of the wonderful aptitude displayed by the Bushmen for music and drawing. This is one of the most striking facts which meet you whenever you compare the Bushman with the Kafir. You find that the Bushmen are a highly ideal, imaginative, and imitative race, and their talent for drawing is very great indeed—very different from anything found among the most educated Kafirs. This matter has already attracted a great deal of attention ; and, as you are aware, the successors of Dr. Bleek have in their possession a number of copies of the best of these Bushmen drawings. I believe there is no assemblage of *savans* in Paris or London who would

not be delighted with the portfolios which may be seen in the possession of Mrs. Bleek and her sister, at Mowbray, entrusted to them by gentlemen who have collected the drawings during many years among the ancient haunts of the Bushmen. I trust that this society may be the means of having these invaluable drawings made better known to the different learned societies in Europe. Yet wider is the field for research regarding the physical characteristics of each race and their liability to change. Most important of all are the intelligent and moral characteristics of each race. On these points anyone with a Kafir or Bushman servant may elucidate facts with great effect. How is it, for instance, these tribes are so attached to their own customs? It would be well, too, if graphic pens, such as are possessed more often by ladies than gentlemen, could illustrate certain peculiarities of their character. Take, for instance, the matter of conceit, which is very extraordinary as compared with the white races, and it is a matter for enquiry in how far this weakness in the negro affects the Kafir. Then there is the matter of fidelity to the chiefs, which is a point of immense practical importance, deserving the attention of politicians as well as societies like this. It is important to know what is the root of the tribal attachment of these people to their chiefs. I should not like to venture an hypothesis, but I must say that all the evidence I have collected on the subject goes to show that it is simply their desire for rule, and the only rule they are accustomed to is that of their chiefs. The question then arises whether for the rule of the chief we may not substitute other and more wholesome rule. Then there is the subject of the indestructibility of the natives. Opinions differ very much on this point. You are told that these races are liable to die out like the Maoris and Red Indians have done. The matter does not admit of discussion now, but let me commend this especially to the attention of all who have the means of making scientific investigation on the subject. Medical men very often have the power of collecting statistics. My own opinion is that the race is indestructible, and this is a most important matter, because it brings us face to face with all facts which must be settled by legislation and other means. The capacity of the

natives for improvement is also another interesting matter for study, and half-a-dozen lectures would not exhaust all that might be said on this point. Let me only ask you in approaching this question, to look to the testimony of men from the days of Parke and Bruce to these of Livingstone and Stanley, and let us consider what those who have known these people best have testified regarding their capacity for improvement, and accommodating themselves to the more powerful northern races. After all, admitting that some practical advantage may be found in knowing something of these races, to what purpose, it may be asked, is all this trouble to be taken regarding people who are at present in a state little removed from primitive barbarism, who must vanish from the face of the earth, or be essentially changed in nature and characteristics before the stronger northern races who have now acquired dominion over them. Would it not be better, if we must have them near us as hewers of wood and drawers of water, that we should simply ignore all differences of race, creed, and colour, and work them as we do our horses and oxen, make what we can out of them, but inquire and know nothing about them save their capacity for supplying our grevious want of labour? This is what is sometimes called a "purely commercial" or "practical view" of our duties. To me, I confess, it has always appeared like everything which ignores facts and consequences, short-sighted economy and eminently unpractical. The presence of these people and our influence over them is a great fact, which cannot be gainsaid, denied, or evaded. According to our habits and temperament, we may regard the fact as a burden or a privilege, but whether burden or privilege let us remember it is a badge of nationality, a sign of empire. It is not given to mere provinces to bear such burdens or to exercise such privileges. The time is passed when by a memorial to this or that distant authority, such burdens could be removed, such privileges conferred or taken away. These colonies are fast growing into a great national confederation, an integral and important member in a vast empire. Removal of this burden is impossible, because it cannot be placed so far away that it shall be out of our influence, or we be uninfluenced by its existence. What is said or done here, not only in our legisla-

ture or in our missionary or scientific societies, but in our commerce and daily life, tells far away, thousands of miles towards the heart of Africa, and promotes or retards our commercial as well as our political influence. It is this which will give us our place among nations on the earth. We think of and estimate our northern homes, by what is intrinsic in the cradle of our race by the fertile soil, the temperate climate, the delights of the homestead, the political right, and privileges of the northern freeman. But other nations judge us merely by what is external—the sway we exercise in India or Java is to them a clearer title to respect than the causes which render such sway possible. That we can rule hundreds of millions of natives of India, that we can secure to them such safety of life and property as they never before dreamed of, that we dare give them such equal rights and privileges as we ourselves possess—that in so doing we can influence the destinies of yet more hundreds of millions of human beings in China or Japan. All these are sober facts, which strike the imagination of other nations more than the hidden causes of such power—they are recognized as unquestionable evidences of power, as the title deeds of an imperial race, to whose delegates place cannot be refused at the council boards of the civilized world. It must be so in South Africa. South Africa with our diamond-fields, and our coal, and our gold-fields, our fertile soil and unrivalled climate, may attract and interest many, but the men of thought and culture, the great economist, as well as men of letters and literature, the religious, the men of science and politicians all who influence the progress and improvement of mankind will ask what has South Africa done with her native races? Has she destroyed and rooted them out utterly and made their fertile lands simply a refuge for white men from the uttermost parts of the earth. Has she allowed them to perish without note of their history, or record of the languages which embody every feature of their mental organization, or has she subdued and converted them to habits of useful labour and civilization, and made them as wise men of old made the barbarian invaders of Roman civilization the subject races of an Imperial mistress, races strong to labour and capable of development into worthy integral sections of population in vast and growing

empires. This is the question now before us; it is for us in South Africa to say how it shall be solved. May He who gives all strength and wisdom enable us to do our part in a manner worthy of our privileges and opportunities (applause).

Wednesday, 31*st July*, 1878.

Ordinary Monthly Meeting.
Mr. J. X. Merriman in the Chair.
Ten Members and three Visitors present.
The Chairman notified that Mr. C. M. Stevens had been appointed Secretary of the Ethnological Section.
Dr. Shaw exhibited a crystal of tourmaline in granite from Namaqualand.

Paper read:—

"Notes on the Strains and Stepe of Continuous Girders, Arched ribs, and Elastic Circles," by Mr. Guthrie.

Wednesday, 28*th August*, 1878.

Ordinary Monthly Meeting.
Mr. H. Bolus, having been nominated Vice-President for the year by the President, Sir Bartle Frere, took the Chair.
Fourteen Members and three Visitors present.

Members elected:—

Mr. Isaac Horak de Villiers,
Ordinary Member.
Mr. Justice Buchanan, of Bloemfontein,
Dr. Emil Cohen, of Strasbourg,
Corresponding Members.

The Rev. Fisk exhibited a tortoise (*testudo pardalis.*)
Mr. Bolus exhibited some dried specimens and drawings of various root parasites, *Hydnora, Sarcophyte, Cytinus,*

Wednesday, 25th September, 1878.

Ordinary Monthly Meeting.
H. Bolus Esq., Vice-President, in the Chair.
Eleven Members and three Visitors present.

Members elected:—

Mr. John Saunders,
Mr. Robert Wilson,
Mr. G. E. O. Stagg,
Mr. Robert Glynn,
The Rev. Canon Ogilvie,
Mr. Koopmans.

as Ordinary Members.

Papers read:—

(1). "A communication on the Flight of Birds from General Shaw" read by the General Secretary, F. Guthrie.

(2). "On Witchcraft among the South African Natives," by Mr. J. X. Merriman.

Wednesday, 30th October, 1878.

Ordinary Monthly Meeting.
Mr. H. Bolus, Vice-President, in the Chair.
Thirteen Members and three Visitors present.

Members elected:—

C. Lloyd Morgan, Esq., of Rondebosch,
E. B. Watermeyer, Esq., of Sea Point,

Ordinary Members.

The Secretary read a resolution of the Council as to the compilation and publication of Catalogues or Lists of Books and Papers on various branches of Science as relating to South Africa.

Mr. Trimen, on behalf of Mr. Schuncke, moved certain resolutions for the formation of a Geographical section of the Society, and for the collection of Geographical information concerning South Africa which resolutions were unanimously carried.

Paper read:—

"On the Geographical Distribution of plants in South Africa" by H. Bolus, Esq., Vice-President.

Wednesday, 27th November, 1878.

Ordinary Monthly Meeting.
Mr. Bolus, Vice-President, in the Chair.

Present eight Members.

Mr. H. E. R. Bright, exhibited some minerals from Damaraland, which had been sent to him by Mr. Palgrave, and made some remarks on the Geology and Mineralogy of that district.

Mr. R. Trimen, exhibited specimens of insects including some Bat parasites of unusual size, and several other rare and curious species.

I. *A Trans-African Telegraph.*—By Mr. Siveright.

[Read, 27th March, 1878.]

The advantages which South Africa would derive from being connected by wire with the rest of the world are too apparent to require to be even so much as mentioned. The question for our consideration is "How is that connection to be made?" Mr. Donald Currie argues in favour of a cable being laid down the West Coast of the continent from Madeira or Cape St. Vincent; Sir James Anderson, the managing director of the Eastern Telegraph Company, is strongly opposed to this route and points out that it cannot stand for a month in comparison with that down the East Coast from Aden. If submarine communication is to be established with South Africa, there can I think be little doubt that the East Coast route is that which should be adopted. For if the line is laid along the West Coast, there is but a single string to the bow as far as Lisbon which may snap at any moment, while the Eastern traffic would at the same time be subjected to an almost prohibitory tariff. At Aden on the other hand a central spot for telegraphic traffic is reached, and owing to the number of lines in more or less direct communication with the place, there would be always one or more alternative routes available in the event of any interruption on one of the sections between Aden and Europe or Aden and India.

But the idea of an overland telegraph across the continent, which has hitherto been dismissed by the majority of people as little better than the dreams of a visionary is, I think, deserving of the most serious consideration.

Before briefly looking at the difficulties which may safely be anticipated in the construction of this overland line let me say a word or two upon the general subject of submarine telegraph cables. Among the dangers to which a cable is subjected, I may enumerate those arising from coral reefs, from abrasion upon the rocks, if

a proper amount of slack has not been allowed, due to under-currents; from sharks and swordfish; and last, but not least, from marine animalculæ; prominent among which, and claiming by right the place of honour is the dreaded *teredo*. The ravages upon gutta percha which have been committed by this worm have led to the expenditure of sums of money that may be counted, not by thousands, but by hundreds of thousand of pounds. I am not aware whether it would be met with in the Indian Ocean or the South Atlantic, but at all events, in making any provision for a submarine cable through those seas, the possibility of its being found would have to be faced. The present type of cable is radically bad, because it does not give us such a form as we can at any future time be certain of raising to the surface again. If the cable has to be raised immediately, or very shortly after it has been laid, you can do it, but after a time the iron decays. Being in a state of oxidation it is heavier than before, and adds to the great weight; it has lost its strength, and as soon as the cable is lifted some distance from the bed of the ocean, provided it is lying in deep water, the weight becomes too much and away it goes. The question may be asked, Why raise the cable when once properly submerged and perfectly laid. Such a question might have been asked a few years ago with some show of reason, but time, which so often corrects where our judgments err, has given the most perfect standing reply, that no matter how well a cable is made, or how successfully it may be laid, circumstances will arise which, with our present knowledge, will impair its electrical power and necessitate its being raised from time to time. The first practical telegraph cable was laid down in the year 1851 between Dover and Calais. It was designed and adopted by Crampton, and consisted of a solid copper conductor, covered with gutta percha as the insulating medium, and surrounded by several iron wires. This outer metallic casing was designed to protect the inner core from mechanical violence, and to confer on the cable a convenient amount of proportionate weight, so as to ensure its being properly submerged. There have been improvements in the conductor, notable among which is the substitution of a strand in place of a solid wire. The insulating medium has likewise been improved, but

Crampton's still remains the general type of submarine cables. I have dwelt at considerable length upon this, in order to show you the risk attending submarine cables, which is too often lost sight of. It used to be the fashion in the early days of submarine cables when the idea of a trans-Atlantic cable was, like those of all great undertakings, in the visionary stage, for the advocates of the scheme to talk about the absolute safety with which a cable would rest in the "placidity and quietude of the great deep"—how no harm could ever reach it in "the eternal impenetrable gloom at the bottom of the ocean"—how forms of life could not possibly exist at such a depth, but that those which swim gaily on the surface in time sink to their "dark, quiet cemetery." We can now afford to quietly smile at all that, and we know that, like everything human, a submarine cable has a term of life assigned to it. If I were asked, What is the life of a long deep sea submarine cable? I should hesitate before giving a reply. I would say that our experience of those which exist does not extend over a sufficiently long period to warrant any definite opinion being formed. I would point out that the 1865 Atlantic cable has been lying quiet for some years now and that the 1866 has followed suit. More than one expedition, well appointed and perfectly equipped, has been fitted out and dispatched with the object of repairing these, but hitherto they have all returned without having succeeded in accomplishing their object. They have succeeded in grappling the cable, but never yet, so far as I am aware, has it been brought to the surface. The protecting iron wires have no doubt corroded, and the cables, in their present state, being unable to bear the weight of any length of themselves, have broken and gone again to the bottom. To give us a submarine cable, the lowest estimate is, I believe, about £1,000,000; a repairing ship which would have be kept on the station would cost from £10,000 to £12,000 per annum. Having said thus much, let us now look into the overland route.

The Egyptian lines have for some time been working as far as Khartoum on the Upper Nile, and Colonel Gordon, writing from the Soudan some four months ago, stated that probably before his letter reached its destination the section from Khartoum to one of the trading stations nine degrees north of the equator would be com-

pleted. He further expresses a hope, which from him is probably as good as the assurance of ordinary men, that within a comparatively short space of time the line would be into Gondokoro 4·54 N., and uninterrupted communication would be established between there and Cairo. On the south, the lines of this colony already extend to Kimberley. Within a few days hence, Pietermaritzburg will be in telegraphic communication with the colony, and His Excellency the Governor is at the present moment taking active steps towards arranging for a line being extended to Pretoria, the capital of the Transvaal. We may, therefore, accept either Pretoria or Kimberley as our southern starting point, and from there to Gondokoro, the northern terminus, the distance, "as the crow flies," would be about 2,000 miles. The route which will have to be followed is a question on which many opinions may be expressed, and relative to which all the available information that can be procured is needed. The grandest, or more strictly speaking, the boldest idea would be to carry the line right straight through the heart of the continent, throwing down spur lines to Mozambique, Zanzibar, and such other places as might seem desirable. Beyond its boldness this, I am afraid, has very little more to reccommend it. That which commends itself most strongly to my mind is to go:—From Kimberley or Pretoria to Tete; from Tete to Zanzibar; and from Zanzibar to Gondokoro. The first section, up as far as Tete, is already tolerably well known, and year by year an increasing number of traders traverse the country between these points. The Zambezi is navigable as far as Tete, which in course of time might thus be made an important centre for the trade of the Zambezi district. Whichever place may be selected as the starting point, Kimberley or Pretoria, it would, in my opinion be advisable to pass Shoshong, the capital of the Bamangwatoes and Gubuluwayo, the residence of Lobengula the chief of the Amandabeles. Both of these tribes are very friendly disposed towards the English, and their towns are already becoming centres of trade and growing importance. From Tete to Zanzibar the line would pass through Blantyre or Livingstonia, the mission settlements founded on the southern shore of Lake Nyassa. From there it would take the route traversed by Livingstone in the earlier days of his explorations to the Zanzibar

territory near Cape Delgado. From this point to Zanzibar, Dr. Kirk says that "a line would be quite secure, and it might be erected with perfect ease and safety." From Zanzibar to Gondokoro the greatest difficulties would have to be encountered, because the territory is neither so well-known, nor are the natives reported to be so friendly disposed as in the districts already traversed. The country, however, is mountainous, and free from malaria. Camels and horses are said to thrive there, and a caravan track exists through a large portion of it. Taking, then, Kimberley or Pretoria, Tete, Zanzibar, and Gondokoro we have four *points d'appuis*, which can be used as starting points and depôts; where ultimately central stations can be formed, and from which the materials can at the outset be laid out. No one section need thus be more than 400 miles in length. Zanzibar is included in the direct line—a matter of no small importance. A growing trade with Europe, Asia, and America is springing up there; it is the port of three monthly lines of steamers, viz., that to Mozambique, Natal, and the Cape; that to Aden; and the French mail line to Mozambique and Madagascar. It is further the headquarters of the Eastern Naval Division. The Sultan may be induced to aid the undertaking by guaranteeing for a term of years, until the line becomes self-supporting, a small annual subsidy. And now let us consider the difficulties, dangers, and risks, which have to be encountered in the construction of this overland line. They may, I think, be summed up as follows:—1. Difficulty of transport. 2. The dangers incurred in passing through a country, much of which is almost *terra incognita*. 3. The dangers in construction that may be anticipated from hostile natives. 4. The difficulty in maintenance, and the liability to interruption of the lines by the uncivilised tribes of the interior. 5. The dangers from monkeys, elephants, and the other *feræ naturæ* of the continent. Before looking at these separately, I ask generally are they confined then to Africa? On the contrary, the same arguments have been urged half-a-dozen times in the history of overland telegraphs and on each succeeding occasion they have been practically met more triumphantly than before. The Russians have carried their lines across the snowy Siberian steppes, a country with which Capt. Burnaby has rendered us, to some extent, familiar—

perhaps the bleakest and most desolate in the whole world. The Australian colonists have completed a line through the heart of their continent from Adelaide to Port Darwin, where difficulties all but superhuman were successfully overcome. In the North American continent there is a line from San Francisco to New York, across the plains of California and Nevada, over the Rocky Mountains, at a height of 8,400 feet above the sea level, and then through 700 miles of prairie. In South America two lines branch from Buenos Ayres; one over the Andes to Valparaiso and Lima, and the other through the heart of tropical Brazil to Jujij. Lastly there is the Indo-European line, which may be accepted as the great prototype of successful overland telegraphs, and which is as well-worked as any telegraph line, open or covered, in the whole world. Facing the difficulties now one by one. 1. Transport.—I have placed this first, because I consider it to be the most serious. From Delagoa Bay to Pretoria, a sufficient quantity of material for 400 miles might be carried and deposited at the latter place. At Tete, 800 miles more might be deposited, 800 miles at Zanzibar, and the last section would have to be worked from Gondokoro unless perchance the river Dana, which is known to be navigable for 100 miles up from Formosa Bay, and may be so perhaps for many more, could be utilized for that purpose. The question of transport leads me for a moment to the consideration of the materials which would be employed, they may be divided into three classes:—(1) poles; (2) wires; (3) insulators. For supports, I would employ wood, where good, durable timber can be obtained, and where it is not likely to be destroyed by the white ant. Upon this point, Mr. A. C. Bailie, of the Surveyor-General's Department in Griqualand, to whom I am indebted for much valuable information, writes to me:—"By the road I went up, that is from Kimberley, it is fifty miles before sufficient timber for an abundant supply of poles is reached. There is thorn wood from thence to the Zambezi, and a quantity of that is available everywhere. Knoppies doorn is the best; it is as hard green as it is when dry, and grows thick straight poles from 30 to 50 feet in length. The stem is covered with knots. Mapani is also a good wood for poles, and grows abundantly beyond Shoshong. So also is a scented wood, called Tamboti,

which is like Sneeze wood, but darker and more fragrant. From Pretoria to the Marico river is about 200 miles; the distance I have not travelled, but from the Marico there is wood everywhere. After reaching the Marico you follow it for twenty-seven miles to the junction with the Crocodile; to Shoshong, 100 miles more; Shoshong to Gubuluwayo 297; all of which is abundantly wooded, so wooded indeed that in many places timber will have to be cleared for the line. Gubuluwayo to Tete is 200 to 300 miles, certainly not more than 300, wood still too plentiful. The white ants abound most at Shoshong. I was told that they do not touch Mapani and Tamboti, and Knoppies doorn is too hard for them. With timber like deal planks they are everywhere more or less destructive, but nowhere worse than about Colesberg." Where wood is not available, iron poles weighing from 100 to 120 pounds made in separate parts of convenient length, and galvanized to withstand the action of any saline deposit or other chemical agent in the soil, would have to be used. (2) The question of *wire* is one upon which owing to my absence from England, I should not like to express any decided opinion. Galvanized-iron wire is, so far as I am aware, employed on all the long overland lines I have mentioned, but there is a form of compound wire, consisting of steel encased in copper, which, if it can only be made to last, would suit admirably for our purpose. The likelihood of its being stolen, owing to its intrinsic value, is reduced to a minimum, I think, when it is borne in mind that the copper is merely a thin external covering. Such a wire would electrically serve the purpose every bit as well as an iron wire three or four times its size, and a ton of this compound wire might, I think, safely be taken to go twelve miles. It is a point, however, upon which I forbear to express any decided opinion; it is one worthy of the best consideration. (3) *Insulators.*—These, being in point of transport the smallest item, may be left to the consideration of the electrical engineer. From the depôts, the transport could be effected by bullocks, through those districts where the tsetse fly does not prevail. Where bullocks could not live, camels might be available, and failing this, native carriers would have to be had recourse to. It may, however, be safely asserted, that on the Australian line the difficulties of transport were far greater

than we need ever anticipate on the African lines. There, every article of material and food had to be transported for a distance, in some instances, of close upon a thousand miles; and if such difficulties have been successfully overcome in Australia, there is no reason, so far as I can see, why they should not be in Africa. 2. "The danger incurred in passing through a country, much of which is almost *terra incognita*" This is, to say the least, a negative danger, and it is one of those cases where, to my mind, "the danger self is here alone" for any party of Europeans. Upon the whole, however, the route, with the exception, as I have already remarked, of a portion of that between Zanzibar and Gondokoro, is fairly well-known. 3. "The danger in construction that may be anticipated from hostile natives." It may be more convenient to look at this in connection with No. 4. "The difficulty of maintenance and the liability to interruption by uncivilised tribes of the interior." This is an oft-quoted difficulty, and one which readily suggests itself to the public mind. The best way to meet it is perhaps to reason from analogy, and see what has been done, and what inconvenience has arisen from this cause on some of those lines to which I have already referred. On the North American continent, the wigwam of the Indian is to be seen as often as the hut of the backwoodsman, along the track of the telegraph wire. On the lines of the Indo-European Company by the payment of a small annual subsidy, provision was made for efficient maintenance and the chiefs, through whose districts it passed, came to regard the wire as the most valuable part of their property, for it alone yielded ready money. It is for this, among other reasons, that I would argue in favour of Shoshong, and Gubuluwayo being placed in the route for the natives would come to regard with greater respect, a line which was evidently under the patronage of their rulers. Coming nearer home, we may instance the case of the Kafirs, at whose hands the telegraph has been treated with the utmost respect. During a most unsettled period, the lines upon the frontier have, under my own personal supervision, worked in a manner which has left nothing to be desired. If then the Indian on the American prairies has come to treat the telegraph, if not with respect, at least with indifference; if the noma-

dic Tartar and Arab hordes in the Euphrates valley; and the Galeka and Gaika in arms in Kaffraria, have allowed it to remain unharmed, we may, I think, fairly argue *à fortiori* that with proper management and upright dealing the native African of the interior districts will not ruthlessly and wantonly destroy the overland line. Then, as to the maintenance of the line, I would propose to have stations at a distance of not more than two hundred miles apart, which may, I believe, on the route we are following, be done without much difficulty. At intermediate points line runners would be placed to whom it could be arranged simply enough to convey morning and evening information as to the condition of the section of line under their charge. 5. The last difficulty is, "The danger from monkeys, elephants, and the other wild animals that are to be met." So far as the monkeys are concerned, the main evil caused by them is that they promote "contacts," when two or more wires run upon the same line of poles. They may, therefore, be dismissed, for there will be but a single wire on this line, nor is there likely to be more for generations to come. So that it may be left to posterity to make provision against the monkeys. The danger from the elephants is much magnified. One may occasionally knock over or pull down a pole, but I could hardly imagine a troop of elephants with so much human malice in them as to proceed to the deliberate destruction of any section of line. It has been suggested that "damage from this cause might easily be avoided by protecting the posts with sharp points or spikes to the height of six or eight feet." I scarcely think that such precautions will be found necessary, nor even if they were, would I place much value upon their efficiency. I have been informed that on the North American line the buffaloes were in the habit of specially selecting a pole with knots or spikes upon it, in preference to one whose surface was smooth. The elephant is equally pachydermatous, and probably would do much the same. These are the main, in fact, all the objections, which I have heard urged against the overland telegraph line. If any comparison were to be instituted between an overland and a submarine telegraph to South Africa it might I think be fairly argued in favour of the former.

First—That it is cheaper. £200 per mile will, I

believe, be found sufficient on an average to meet the expenses of the undertaking.

Secondly.—It is more reliable. I mean by this, that although the interruptions on an overland line may be more frequent, they must as a rule be of very short duration, and that whereas a cable may remain for months silent at a time an overland line properly maintained ought not to be broken down for more than twenty-four hours at a stretch. And when the distances come to be corrected by thousands of miles, the delays in hours are really of trifling moment compared with the risk of a community losing altogether for an indefinite time the privilege of telegraphic communication after it has been once accorded to it.

Thirdly.—Looking at the subject from a purely monetary point of view. An overland line begets traffic along its route and the stations that might be established would in course of time become self-supporting. A cable on the other hand, simply develops the traffic at and between those points where it touches.

Fourthly.—With an open line of telegraph we know what we have got. The poles, wires and insulators are a real solid property which will last with certainty for a term of years. With a cable—at least with the present type of cable—we do not know what we have got for at any moment it may go faulty and its repair after a time is at best but a matter of probability. Under any circumstances the time comes sooner or later when the cable can no longer be lifted and a duplicate line must be laid to take its place.

I have purposely avoided any reference to the civilizing effect which an overland telegraph would have upon Central Africa: the impulse which it would give to missionary enterprise, to mercantile adventure, and to the spirit of travels, needs but to be named. Nor have I made any allusion to the political effect which such an undertaking would have when, amidst the present European difficulties, Germany, so the last mail from England told us, is advocating a British occupation of Egypt.

It is to be regretted that His Excellency Sir Bartle Frere, the President of the Society, is not present with us this evening. No one takes a deeper and at the same time a more active interest than he does in this

question of telegraphic communication, nor do I know of one better qualified then he with his large experience and extensive knowledge to pass an authoritative opinion upon the subject of a Trans-African Telegraph.

II. *Rainfall of South Africa.*—By John G. Gamble, M.A., M. Institute, C.E.

[Read, 26th June, 1878.]

[NOTE.—The Maps referred to have not been printed, but the table at the end of this paper gives the materials from which the maps were compiled.]

In designing these maps and in exhibiting them to the Philosophical Society I have wished to arouse some interest in rainfall measurement, and to elicit some discussion of the causes of the distribution of rain in South Africa, rather than to set forth any new views of climate or meteorology.

Scantiness of Materials.

It is much to be regretted that there are so few materials for a discussion of the meteorology of South Africa. The only really satisfactory series of observations is that taken at the Royal Observatory, from which we have now thirty-seven continuous years of rainfall measurement. At Port Elizabeth a continuous meteorological record has been kept by Mr. Charles Hammond, the lighthouse-keeper, since 1866; and we have rainfall records since 1861 kept at Graaff-Reinet by Mr. Alfred Essex; as well as good registers from Groote Post near Malmesbury, from Nel's Poort near Beaufort West, from Aliwal North, and from a few other places; but, as a rule, the information as to the rainfall of the vast districts in the interior of South Africa is sadly deficient. In 1862 the first report of the meteorological commission was published, and subsequently results were printed embracing the years 1861 to 1868; but for some reason or other the zeal of the observers flagged, and the commission left off publishing. Since 1875 however, results have again been printed, but the stations are few, and the observations often intermittent. As to the rainfall, which is the matter in which I am specially interested, I have endeavoured to

collect registers for the period between 1868 and 1875 when they were not printed by the commission. Advertisements were put in the papers about a year ago asking all people who had rain-gauge observations to send up copies of their registers to the secretary of the meteorological commission, and intimating that such documents can be sent post free. In consequence I have accumulated from manuscripts, as well as from the available printed records, a large quantity of information, but I have to deplore many notable gaps in the registers. For example, I have not been able to get all the observations from a place so near us as Wynberg, though I have taken some trouble in the matter. At Graham's Town observations were taken as early as 1850, I believe by the Royal Engineers, but I have not been able to get all the statistics. I believe there have been observations taken in Natal which I have not seen: the authorities there have promised to send me a set of the records, but hitherto nothing has arrived. I am indebted to the last book of that diligent collector of authorities, the Rev. J. Croumbie Brown, for a series of nine years' observations taken near Port Natal. Some observations appear to have been taken at Harrismith in the Orange Free State, but I have only got the total of one year. At Motito in Bechuanaland, north of the Diamond-fields, I have the monthly totals for one year, but no more. Whether more observations have been taken or not, I have not yet found out. I need scarcely point out how very valuable any records from such a station would be.

Explanation of the Maps.

The maps exhibited consist of four large wall-diagrams representing the coast-outline of South Africa, with the number of inches of rain at various places during each season of the year, marked in red figures. Each map represents a season, summer being taken as December, January and February, and so on. The five smaller diagrams represent the Cape neighbourhood, and give the rainfall for the same seasons, and also for the whole year. It is an unfortunate but quite unavoidable point with regard to these maps that the red figures at different places do not represent the same period of years. Thus the figure representing the fall at the Royal Observatory is the mean of thirty-six complete years, that at King

William's Town the mean of only nine years and a half, and so on with the others.

Difference between East and West.

One obvious point, that strikes anyone who either examines these maps or travels in this country, is the marked distinction between the East and the West. Natal and the Eastern Province get their rains chiefly in summer when the South-East trade wind blows. The Western portion of the Western Province gets its rain mainly in the winter with the North-West wind. This wind seems to be a similar meteorological phenomenon to the South-West wind of Western Euope, called the return trade by Halley 200 years ago, and, perhaps more correctly, called by Herschel the Anti-trade. We may note that the anti-trade of the Western Province comes apparently from a portion of the equatorial regions that is occupied by sea, while the North-West winds that blow in the Eastern Province, if they really keep their theoretic curvilinear path, and are not interfered with by the height or temperature of the ground, come from a portion of the equator where there is land, and consequently small evaporation. The midland districts seem more connected with the East, getting their principal supply in the summer, but owing their moisture mainly to thunder storms, which, though they occur at a time when the South-East is prevalent on the coast, yet frequently appear to come from a North-West direction. This was pointed out by Mr. Ella, who, when in charge of the Katberg Road, reported that there were three belts of climate: on the coast side of the Katberg, the usual periodic rains of the Eastern Province; on the top of the Katberg* constant rain in summer from the South-East; but to the northward heavy thunder storms from the North-West which swept the northern face of the Winterbergen and Amatolas, and went on in a North-East direction towards Natal. When I was on the Orange River, at Prieska and further down, the thunder storms seemed to come from the westward; but a very grand storm which I witnessed in the Calvinia Hantam

* The top of the Katberg pass is about 5720 feet above sea level. The village of Balfour at the foot of the Katberg on the coast side is about 2160 feet above sea level.

came from the South. These midland storms are often of very small extent, heavy rain falling on one farm while it is dry all round.

It is frequently said that in such and such a year there was a drought in the *colony*, in another year heavy floods in the *colony*. This way of speaking is incorrect, for, in consequence of the very distinct climates of the East and West respectively, which I have already alluded to, it is very rare that a drought occurs all over South Africa at the same time. Mr. Fox Wilson in a paper printed in the Royal Geographical Society's journal for 1865, says there was a drought in the *colony* in 1862. He adds that it was especially severe in Basutoland. On examining the registers we find that there was a severe drought at Graaff-Reinet, only seven inches falling in the year. This is eight below the average. At Uitenhage it was not so marked, twelve inches falling or three below the mean, while at Pietermaritzberg there was an average fall. But when we come to the Western Province we find that on the contrary the fall was superabundant.

The Royal Observatory records give	32	inches or	8	above the mean.
Town House, Cape Town "	29	"	3	"
An observer at Sea Point gives	28	"	7	"
An observer at Simon's Town gives	36	"	7	"
An observer at Somerset West gives	29	"	6	"
Mr. Blore at Wynberg marked	68	"	28	"
and even at Worcester there was	21	"	8	"

while from Concordia, in Namaqualand, the almost incredible fall of fourteen inches was reported. On examining the registers we find the explanation of this difference between East and West. The drought at Graaff-Reinet was owing to the failure of the summer rains, and especially of those which are generally expected in February, while the Western Province downpour was owing to the winter rains, as much as forty-five inches of rain being recorded by Mr. Blore at Wynberg for the three months, June, July, August of that year.

The drought of last year 1877 was very severe in the Midlands; only four inches fell in the whole year at Nel's Poort, the smallest yearly total ever registered there. This drought was chiefly, though not entirely, a summer drought; at Graaff-Reinet there was again the failure of the February rains, but the rains in the West were excessive, over twenty-three inches being registered at

Bishopscourt in the month of May alone. The May rain of last year is traceable at Clanwilliam, but not at Fraserburg, Carnarvon, or Amalienstein (near Ladysmith), and is only slightly noticeable at Mossel Bay.

As an instance of the local character of the Midland rains, I find that, though Graaff-Reinet did not get its February rains last year, yet four other observers in that neighbourhood, Mr. Brooke of Goliaad's kraal, Mr. Rubidge of Welwood, Mr. Laharpe of the Glen, and Mr. Watermeyer of Letskraal had an average supply in February.

The entire separation of the Western portion of the Western Province from the rest of South Africa, is shown by Mr. Sidney Jackson of Brakfontein, who says that, when it rains near Cape Town, it very seldom rains in Victoria West, and that the summer rains in Victoria West rarely set in until the Cape South-Easters begin to blow.

We notice that places close to the East Coast do not exhibit the same decided monsoon feature as the interior and the West, or perhaps we should say that the monsoon feature is masked by other causes. Thus at Port Natal March is the wettest month. At both Port Elizabeth and Uitenhage, October and November are the wettest months, while January is dry at both. Is it that the clouds flying higher in summer are able to pass over Port Elizabeth and the coast ranges without depositing moisture?

With regard to the boundary line between the two climates, there are not enough observations to give any satisfactory result. We may, however, expect that the boundary will vary somewhat from year to year, and that it will be a belt rather than a line, over which belt the peculiarities will gradually diminish. Thus at Worcester there was a heavy fall in February, 1863, which is not observable at the Royal observatory, or at the Town Hall. As this February there were heavy rains at Nel's Poort and at Graaff-Reinet, and even at Mossel Bay, we may almost infer that the summer rains came past their usual boundary. The February rains are traceable however in the yearly curve for Wynberg and Worcester, and even in Namaqualand February seems more favoured than January or March. It may be noted that at Amalienstein the winter rains are some-

what in excess of the summer, while the maximum is in autumn. I think that Amalienstein is not far from the average boundary between the two climates.

Effect of height on rainfall.

Another point that is clear to all is that as you go inland you get drier, thus Worcester is drier than Cape Town, Uitenhage than Port Elizabeth, Pietermaritzburg than Port Natal. But there is a law which somewhat interferes with this, and that is that as you go uphill you generally get into a wetter climate. Thus the rainfall on the Katberg is probably as heavy as that of any other place in the Cape Colony. Heavy rainfall is generally found on that slope only of a *very* high mountain chain, which is exposed to the rain-bearing wind, but in the case of *moderately* high hills both slopes have a heavy rainfall. This is seen in India where the South-West monsoon crosses the moderately high Western Ghauts and feeds the sources of the Madras rivers ; but is said not to cross the lofty Himalayas. Similarly Table mountain is apparently not high enough to prevent the North-West winds from depositing considerably more rain at Bishopscourt and Wynberg than they do at Sea Point and Cape Town : while at the much higher Katberg the South-East rains penetrate but a short distance beyond the summit. I say purposely as you go *uphill* the fall generally increases, and not as you go *higher*, for it is a well-known and curious fact that, wherever observations have been taken, it has been found the precipitation is greatest near the surface of the ground, and decreases gradually with the height. For example the annual fall of rain on the roof of the Paris Observatory is two inches less than on the ground beside it.

Among the curious points suggested by these maps we note that the summer fall at Brakfontein, Victoria West, is five inches, while that at Nel's Poort, Beaufort West, is only three. When I first saw this I thought it must be owing to the fact that I have only records for four years and eight months at Brakfontein, while I have nearly fourteen years for Nel's Poort. And perhaps in consequence of a rather heavy fall at Nel's Poort, in January, 1876, the figure 5 is rather high, yet on comparing the totals of the four years 1873, '74, '75, '76,

during which the observations were simultaneous at the two stations, I find that in each year there was two inches more rain at Brakfontein than at Nel's Poort. The former is about 1,000 feet higher than the latter; whether this has anything to do with the increased fall I cannot at present say.

Desirability of observing duration of rainfall.

An important point with regard to rainfall is the length of time which each shower or storm lasts. Observations made in France have shown that one inch of drizzling rain lasting seven hours penetrated four and a half inches into the soil, while three inches of heavy rain falling in one hour and a half only penetrated two inches; thus one-third of the quantity penetrated more than twice the depth, because it fell gradually instead of rapidly. This is an important matter for the Karroo farmers, who get most of their meagre allowance in thunderstorms. It is reported that four inches once fell in two hours at Victoria West. Of course only a small portion of this sinks into the ground, the rest passes away rapidly down the river-beds to the sea, and is lost. The new rainfall registers lately issued have columns in which the observer can note down when the rain began and when it left off. I may note in passing that the fact of the rain falling, when it does fall, in heavy showers in a short time, though unfavourable to the actual land it falls upon, is more favourable for the filling of storage reservoirs than a soaking rain.

Sunspot period.

Had the records been ampler it would have been interesting to have examined whether the coincidence between the periodic maxima and minima of sunspots and the maxima and minima of rainfall which Mr. Stone has pointed out for the Royal Observatory here, and which has been noticed in other parts of the world, holds good of up-country stations. If we compare the rainfall of the three minimum sunspot years '65, '66, '67 with that of the maximum years '69, '70, '71, we find that in the three maximum years the rainfall was considerably heavier at Cape Town and Worcester, somewhat heavier

at Uitenhage and Graaff-Reinet, but at Nel's Poort it is the other way, the rainfall of the three minimum years being the greater.

Observations and Observers.

During the last year a large number of new rainguages have been distributed over the colony, and we may hope in a few years to add to our knowledge of the climate of this part of the world, climatic questions not requiring such a long period of observations as some others, such for example as the somewhat delicate question of coincidence with the sunspot period.

I have to thank many observers for their readiness in copying out for me, or lending me, their registers. I would not wish to be ungrateful, but it is an unfortunate act that some observers cannot add up or take means correctly. Hence it is very desirable to have access, where possible, to the original register. Another trouble is that some observers have not distinguished between a month in which there was no rain, and a month during which they were away on a holiday, and took no observation. Of course when an observer is absent he should provide a deputy, but this has not always been done.

Conclusion.

I regret much the small amount of new matter that I have been able to bring before the society; still if I succeed in eliciting an interesting discussion among the many members of the society who, from longer residence in the colony or for other reasons, are better qualified than I am to deal with this question, the labour I have taken in calculating means and designing these maps will not have been spent in vain.

RAINFALL IN SOUTH AFRICA.

Table from which wall diagrams were compiled.

PLACE.	Spring.	Summer.	Autumn.	Winter.	Year.
Royal Observatory, Cape Town	5	2	6	11	24
Town House, Cape Town	4	2	7	13	26
Sea Point	5	2	5	9	21
Bishopscourt	12	6	11	22	47
Wynberg	9	2	6	23	40
Simon's Town	6	3	7	12	29
Somerset West	5	1	5	12	23
Stellenbosch	6	1	7	9	23
Bredasdorp	4	3	5	6	14
Worcester	3	1	3	6	13
Groote Post, Malmesbury	3	2	5	9	19
Clanwilliam	1	1	3	5	10
Concordia, Namaqualand	1	2	2	5	9
Keerom, Namaqualand ...	2	1	1	4	8
Amalienstein	4	3	6	4	18
Nel's Poort, Beaufort West	2	3	3	1	9
Brakfontein, Victoria West	3	5	3	1	13
Graaff-Reinet	4	6	4	2	15
Goliaad's Kraal, Graaff-Reinet	3	5	4	2	14
Somerset East	5	6	6	2	19
Uitenhage	6	3	4	3	15
Port Elizabeth	7	5	6	6	25
Graham's Town	8	8	7	4	30
Aliwal North	5	12	6	1	25
Queen's Town	4	11	6	2	24
King William's Town ...	7	11	7	3	29
Pietermaritzburg	10	13	6	1	30
Merebank, near Port Natal	12	13	14	6	44

N.B.—The figures mean inches of rainfall. The annual fall will not be found always to agree with the sum of the seasons, as in some cases I have got yearly totals without monthly totals, and I have preferred to make the yearly mean more accurate by embracing these, than to make the table perfectly symmetrical.

JOHN G. GAMBLE.

III.—*Stray notes on the Geology of the Fort Beaufort District.*—By Henry W. Piers.

[Read, 30th January, 1878.]

Fort Beaufort is situated on a long tongue of land, formed by a curvature of the Kat River. It consists of hard condensed red clay, derived from the decomposition of greenstone trap rock, and it rests on blue or dark grey shales. On the opposite side of the river, and between it and the precipitous high land to the North, is a flat on which is the race-course. This flat is the "Golgotha" of Bain, the scene of his first discoveries of reptilian fossils, especially those of the Dicynodon, which is a gigantic lizard, having two long tusks depending from the upper jaw.

The high land or cliff bordering this flat is made up of shales identical with those on the flat, having a slight dip to northward. Upon the shales, rests conformably, a capping of basaltic rock, which is a characteristic of all the hills in this and the Kaffrarian districts.

There are in the shales several alternations of hard, and of frible beds, indicating the intermittant action of heat from igneous sources; the surfaces of exposed hardened beds are pitted, and even vitrified, by contact with incandescent matter—and in one spot I discovered bones imbedded in the hardened rock, the ends of which, at the outer edge of the rock, were blackened and vitrified, in fact having the most natural appearance of partially burnt bones. It is very remarkable however, that throughout the stratification of the shale, no igneous matter is to be found that can possibly account for this alternation of soft and hardened beds, the latter being about three or four feet thick. At varying intervals there are continuous strata, which mark distinct periods, and action, besides that already mentioned, namely bands, or strata, largely interspersed with septarian nodules. In these I

failed to detect any sign of organism; they are intersected with irregular lines of cule spar, producing curious spider-like figures; they can be converted into a good hydrolic lime, but are not so applied I imagine, because the necessary processes would be too costly, or the cost of transport would be too great, to an available market. It is a curious question, from whence was this form of lime derived? there being no other indication of calcareous matter throughout the shales, except one narrow horizontal band, two inches thick, of carbonate of lime, low down in the series, and there are no shell fossils. Bones of Dicynodon are numerous.

Between Fort Beaufort and Dance Hoegte there extends a caurse sandstone, lying in some places on, and in others, (as for instance at Fort Beaufort) passing under the blue shales for a short distance. It is conformable with the stratification of the shale, and is called the Beaufort Grit. Apparently non-fossiliferous, although in some spots, loose on the surface, I have frequently found fragments of silicified wood, showing the internal and external structure most minutely and perfect. This sandstone, which forms an escarpment or wall, along the face of which the Kat River flows, at the bridge, is, I conclude, the wall of a dyke, the contents of which have disappeared, for it is evidently metamorphic. It has become a hard crystalline rock. It has been extensively quarried for building purposes, so that its internal structure can be studied. The vertical fracture exhibits fine parallel lines, alternately blue and white. These are horizontal, perfectly right lined and parallel throughout, either in the direction of the dip or strike, and can be split into as perfectly flat slabs. It is thick bedded and is vertically divided by oblique divisional planes, all oblique to the bedding, strike and dip. That it is metamorphic I believe, because it is uniformly the same over a distance of more than fifty miles in the direction of Kafirland—is without the slightest appearance of foreign matter, or a single irregularity of form or colour, and gradually and imperceptibly it passes upwards into the flaggy coarse, micacean grit. Its original aqueous character I have detected in a few isolated spots, where, in the face of the quarries, an obscure but sufficiently definite trace of undulating bedding was discovered passing from one bed to another.

About a mile from Fort Beaufort and south-west from it, there is a gully in the sandstone running from west to east with a considerable fall, so that only during heavy rain, is there a stream of water running down it, but at intervals, there occur several circular deep pools, surrounded by bush and trees, in which very many water tortoises may be seen moving about. The banks of this gully are perpendicular consisting of the coarse grit. The floor is finer and harder. In the southern face of the side walls are a number of curious indentations called Bushman caves, they are of various dimensions, say from one foot six to three feet deep, about four feet high and from eighteen inches to four or five feet wide in the opening. The roof even is internally dome-shaped and the floors are more or less concave. These cavities are the result of natural disintegration, and apparently altogether due to the action of the sun's rays, for it is only when exposed to the sun's light, that this rock breaks down. The rock forming the northern face of the gully shows no sign of disintegration. At first I fancied the caves to have been scooped out by water, until I observed that on the opposite side the same rock was intact, and also that the bottoms of the caves were about two feet above the floor of the gully. I then noticed that the walls inside were shelling off in the hottest and driest weather, whilst at the same time that portion of the rock above the openings, which was protected from the sun by a thick growth of bush and grass, remained hard and sound. This upper portion of the rock appeared to owe its immunity from disintegration to its moist state, occasioned by infiltration from above. The floor of the gully descends by steps of successive strata, varying in width from twenty to fifty or more feet. In, or on the surface of several of these steps, there are curious snake-like forms, stretching across the gully; they are parallel to each other, round in form, slightly undulatory longitudinally, but not tapering to either extremity. The substance of them is a dark chisty rock, and though bedded in the sandstone, the upper surfaces project two or three inches above, some of them are from two and a half to eight inches in diameter. I am at a loss to conceive what these substances can be, or how produced. They are all parallel to each other, lying approximately north and south, and all in different beds of stratification; they

are of various lengths, from twelve to twenty feet and upwards. Certain portions which I disturbed, came off in flat transverse disks of three or four inches in thickness, and quite devoid of any sign of organic structure.

The late Mr. A. G. Bain drew my attention to a solitary boulder, below the drift crossing the Braake River, on the road to Alice. From it he had extracted some fossils of fish, and recommended my seeking for more. It was a large block of sandstone in which was a band of about three inches in depth, containing the fossil fish of the ganoid and heterocercal character, none were three inches long. The scales and fins were perfect. I failed, as did Mr. Bain, to discover from whence this block could have been detached; apparently it could not have been from any great distance up the river valley, as it was not waterworn, and the course of the river was through much of the same rock, but the fossiliferous band could not be detected in situ. Between Fort Fordyce, which is situated on that part of the Cromme range overlooking the Waterkloof, and Post Retief, near the Winterberg, bands, or it may be dykes, of what is called ironstone gravel, occur, having an east and west direction, or coinciding nearly with the strike of the rocks. I have never had an opportunity of examining them in section, but have been told that some can be seen to traverse the adjacent Blinkwater valley. One of these bands, crossed over by the road to Retief, is from eighty to a hundred feet wide apparently, but may possibly consist of three or four parallel dykes, as it is only in recurring patches of the roadway, that this ironstone is discernable. The structure of the gravel is botryoidal, dark with polished surface, internally reddish and earthy, with minute particles of metallic lustre, probably it contains manganese and pyrites.

IV. *On the peculiar Colours of Animals in relation to Habits of Life.*—By M. E. Barber, (Communicated by the General Secretary).

[Read, 26th June, 1878.]

On reading Mr. A. R. Wallace's interesting paper published in MacMillan's Magazine "On the Colours of Animals and Plants," several important facts recurred to my mind, which I have endeavoured to embody in the following pages. They are all of them more or less intimately connected with the subjects discussed by Mr. Wallace, and may perhaps be the means of throwing additional light on these matters, especially as there is so much that we have yet to learn, for it is only of late years that naturalists have given their attention to these interesting subjects. And to Mr. Darwin we are mainly indebted, to him we owe our thanks for putting us upon the right track; it is comparatively an easy task to follow in his footsteps, and to spell out the book of nature with Mr. Darwin's alphabet in our hands. We need not however be vain or presumptuous in our wisdom and learning, as we ourselves are but a link in that wondrous chain which connects all earthly things. There is not a bone or sinew in our frame which is not represented in that of all creatures, even in the serpent beneath our feet, which we despise and dread. If we have in the struggle for existence climbed to the top of the tree, and assumed dominion over the lumbler inhabitants of the earth let us not exult in the strength of our position, we may not always hold our own, other creatures have had their day, and have vanished from the face of the earth, and this may also be our doom; far be it from me therefore to imagine that all that is grand and beautiful in nature, together with the wonderful tints of birds, and flowers with their sweet perfumes, &c., were solely created for the gratification of human beings; or that it is possible for flowers "to waste their sweetness on the desert air."

In the beneficent economy of nature there is no absolute waste or squandering of materials, she is only lavish where it is strictly necessary ; every form and colour has its own intrinsic value, or use, its place in the appointed season; although, as yet, many of them are altogether beyond our limited comprehension.

Colour throughout nature, as far as investigation extends, is not the result of accident at all, "accidental colour" is a vague and empty term applied by some naturalists to brilliant hues, the uses of which to them appear obscure or purposeless, colours in fact which they do not understand. In the economy of nature colour is employed for innumerable and widely different purposes, none of which are accidental (not even in cases of variegated foliage), on the contrary its uses are of the utmost importance in their various applications and expressions. No word-painting could be more effective, or could tell a tale of greater interest than do the different significations of colour as applied in the various services of nature to animals and plants.

Typical colour is, however, by no means to be depended upon. It is not so much the result of near relationship, as of similar habits. The species of widely different genera harmonize in colour where their habits are similar and *vice versâ*. Mark the striking difference that exists between the common dove (*Turtur Semitorquatus*) clad in her modest coat, and the dove of the Transkeian country (*Treron Delalandii*) arrayed in glorious shades of light and dark green, with red beak and legs. In form both species are alike ; remove the feathers and you will not distinguish the one from the other, dissimilar habits have produced in these nearly allied birds, this remarkable difference in colour.

Mr. Wallace, I find does not agree with Mr. Darwin in his theory of female selection ; he does not consider it to be mainly the cause in male birds of the production of brilliant colour and ornamentation. Now although to a certain extent I admit that there may be something in what Mr. Wallace says, for doubtless strength and vigour in birds tend to the production of perfect feathers, as in quadrupeds a high state of condition will produce a superior coat of hair ; I have, nevertheless, so frequently seen and watched the display which male birds of various tribes are in the habit of performing during the early

spring or pairing season, when they collect in great numbers in certain localities and sing before the females, that I cannot bring myself to believe there is nothing in this theory, even were I inclined to do so.

The peacock with his wonderful train is never weary in the pairing season of exhibiting and displaying his grand colours and markings before the females, strutting backwards and forwards at the same time in the most stately manner, and calling attention to his movements, being at this season exceedingly proud of his fine feathers, and moreover, taking the greatest care of them during rainy weather to prevent them from becoming soiled. I was once told by the late Sir Walter Currie (who was a man of great observation) that his peacocks would rather starve than quit their perches when the earth was wet and muddy, and that he frequently went round and fed them from his hand out of sheer pity for their starving condition. No sooner, however, was the pairing season over, than no further care was taken of the fine train, it was draggled in the mud or ruffled against wet bushes, and but seldom exhibited or displayed. However it is not improbable that in the wild state of the peacock, this extraordinary appendage may also have been used to scare away predaceous creatures from the vicinity of their nests or young. Its sudden expansion, together with the defiant note uttered by the bird, and the wonderful display of colour and imitation "eyes," with their waving lashes or apex of each feather, would in itself be sufficient to startle any creature unaccustomed to such a sight; in the same manner as a lady in India is said to have baffled a tiger by the sudden expansion of her parasol.

The numerous species of sunbirds (*Nectarinia*) will spend hours together in the early spring season, singing, and displaying their brilliant plumage before the females. I have frequently watched the males doing so, one morning in particular, when I was observing this habit in the common redbreasted sunbird (*Nectarinia Afra*), a male was perched upon a low flowering shrub, where he was singing and displaying his beauties in the most excited manner, with many a bow and gesticulation before a couple of admiring females, while they, ever and anon were answering him in so many pretty little chirpings, (the females do not sing). At length one of them (his favourite I presume) uttered a shrill note, as much as to

say, "I have had enough of this sort of thing," and away she darted through the air, evidently much to the disappointment of her suitor, for his song was abruptly concluded, and she was immediately followed, whilst the other female uncared for was left behind. All the display of fine feathers and singing takes place in the beginning of the season, before the toils of nest building, and rearing of young commences; for in these arduous duties the male takes his full share, assisting his mate in various ways. When the young (which are usually male and female) are fully fledged and in a fit condition to abandon the nest, the male sunbird takes the young female under his entire care, and the female the young male. In colour the young closely resemble each other, both possessing the hues pertaining to the female sunbird, the male, however, being somewhat larger and longer in body. After the parent birds have finally separated with their young charges, they become exceedingly jealous of each other, and angry disputes take place between them, when they may be seen driving each other away from favourite haunts, and flowers; how long this animosity is kept up between the old birds I cannot tell. Sunbirds, however, return again and again to the same localities to build their nests, not caring whether they have been successful at these places in rearing their young.

Cape canaries (*Crithagra canicollis*) have their favourite haunts, usually where the morning sunbeams find their way to sheltered nooks and trees; at such places they will collect in great numbers, where the males will employ their time in singing and displaying their pretty yellow coats, for hours together before the females. These "love meetings" invariably take place in the pairing season. After each has chosen a mate, the early morning gatherings cease, the singing considerably diminishes and the more earnest work of nest building commences. Like the canaries the yellow finch (*Hyphantornis olivaceus*) or "reed sparrow" as it is commonly called in this country, has the same habit. These birds are, however, more numerous and noisy in their gatherings than the canaries. Their favourite haunts being reed beds, or trees overhanging precipitous cliffs or water courses.

Many species of birds, however, choose their mates once for all, and they live together (provided no accident occur

to either sex) throughout the natural term of their lives, in such cases there is but little display on the part of the males of fine feathers, or singing to enchant the females; such birds pursue the even tenor of their way as do married people of the human race, displaying, however, great affection for each other, which is not always the case on the part of human beings. The domestic fowl cares not a straw for the beauty of plumage, the females swear allegiance to the strongest and most victorious fighting bird of the "clan," no matter what his colours may be, and to him they look for protection from the importunities of younger males, and from the attacks of dogs, cats, etc., etc.

Indicative or banner colour.—There is an important use to which brilliant or conspicuous colours are adapted in male birds, on which Mr. Wallace, in his paper on "Colour," does not in my opinion, place sufficient importance. I refer to *indicative colours*, where the plumage of the male is more brilliant and conspicuous than that of the females, and where the male is polygamous; in all such cases the male takes the lead by proceeding in whatever direction he thinks proper, followed by the females; the bright colours of the male, like the banner of a Regiment, forming the guiding star to the band. With regard to these polygamous birds, there are frequently as many as seven or eight females to one male, and great confusion would take place if the male did not take precedence and upon all occasions become the leader of this little band of females.

The black and yellow finch (*Ploceus capensis*) commonly called in this country the "Artillery bird" on account of its black and yellow colours, is one of these polygamists; there are seldom less than from six to eight females in his establishment. The female is a dun coloured little bird of no account, as far as beauty is concerned, whilst the male on the contrary is arrayed in the deepest velvet black, contrasted with bright yellow. Of these gay colours he is exceedingly proud, displaying them in various ways before the females, by throwing out his wings in a rapid manner while flying or while perched upon some lofty reed or water bush, etc., etc. The "Artillery bird" frequents river sides, or marshy places, where reeds or long grass abound. Their nests are neatly constructed, and covered in with the stems of long

grasses, rendering the female invisible while on the nest; these birds build in small colonies, the nests being near to each other, enabling the male to superintend them all. In autumn the male changes his bright coat of conspicuous colours, assuming one which closely resembles that of the females, at which time the family becomes dispersed in search of food, or they unite with other families of the same species, and visit corn-fields in large flights.

The long tailed black finch (*Chera Progne*) has similar habits to the "Artillery bird," he is also a polygamist, and possesses a harem of inconspicuously coloured females. His long tail feathers form the leading banner of the family party. The tail of the male is indeed of such inconvenient length, that in stormy weather, if alarmed he does not seek safety by flight, like other birds, but is compelled to secrete himself beneath the long weeds and grasses, leaving the ladies of the harem to shift for themselves in the best way they can. In the winter season, however, the long tailed finch is happy in being enabled to cast off his long tailed black coat, for a brown one, like that worn by the females, his only distinction then being the red patches on the wing coverts, and a somewhat greater length of body. However when the breeding season is past, and the days of his pride are over, many families then unite and dwell together, roosting among the reeds.

It may be that among mammals also conspicuous colours are of great value. For instance, there is a tendency in all the creatures that are allied to the *Equus* or horse tribe, to be striped. The zebra and quaggea of this country are both striped, especially the former; why they are marked in this conspicuous manner, is difficult to say, but doubtless these stripes have their peculiar signification and value.

The different species of large game of South Africa are frequently found feeding together in numerous droves, scattered over the wide plains, and they drink habitually at the same watering places, moreover, it is the custom of these créatures to drink, not during the day so much as in the night season, or the early dawn of the morning. Zebras frequent mountain ranges or hilly localities, consequently they are not so frequently found upon the plains in company with other kindred

species, but nevertheless they are compelled to drink at the same watering places, where they intermix with other creatures, and it is not improbable that the conspicuous stripes of the zebra may be indicative or banner colours, which would enable them, after having quenched their thirst, with the general troop, to follow each other and keep together, or to separate from them even in the darkness, or in the dim indistinct light of early dawn.

Protective colour.—There is no other purpose in nature to which colour is so widely and universally adapted as that of protecting its possessor from observation, and thus rendering it comparatively safe from dangers of innumerable kinds. Who has not looked in vain for the little mottled partridge, so like in colour to the locality in which it occurs, when suddenly startled by the whirring sound of its wings, as the bird rises from almost beneath their feet! However, the advantages of protective colour have been described by many able naturalists, and I shall confine myself entirely to cases that have come under my own observation, and hitherto undescribed. It is not only sombre and inconspicuous colours that are absolutely necessary for the protection of their owners, but likewise the most brilliant and superb. A casual observer would scarcely imagine that the highly varnished, and magnificent coloured plumage of the various species of sunbirds (*Nectarinia*) could be of service to them for this purpose (as well as in that of "female selection") yet this undoubtedly is the case. The most unguarded moments of the lives of these birds, are those that are spent amongst the flowers, it is then that they are less wary than at any other time. It will be remembered that sunbirds subsist almost entirely upon the nectar of flowers. The different species of *Aloes* which blossom in succession, form the principal sources of their winter supplies; and a legion of other gay flowering plants in spring and summer, the Aloe blossoms especially, are all brilliantly coloured, and they harmonize admirably with the gay plumage of the different species of sunbirds. Even the keen eye of a hawk will fail to detect them, so closely do they resemble the flowers they frequent. The sunbirds are fully aware of this fact, for no sooner have they relinquished the flowers than they become exceedingly wary and rapid in flight, darting arrow-like through the air and seldom remaining

in exposed positions. The black sunbird (*Nectarinia Amethystina*) is never absent from that magnificent forest tree the "Kafir Boom" (*Erythrina Caffra*); all day long the cheerful notes of these birds may be heard amongst its spreading branches; yet the general aspect of the tree, which consists of a huge mass of scarlet and purplish black blossoms, without a single green leaf, blends and harmonizes with the colours of the black sunbird to such an extent, that a dozen of them may be feeding amongst its blossoms without being conspicuous, or even visible. This fine tree, which blossoms early in the spring, forms the favourite haunt of this species, and amidst its branches they collect in considerable numbers, holding their "love meetings" and singing and chirping for hours together in bright sunny mornings.

The colours of the green wood-pigeon of the Transkeian country (*Treron Delalandii*) so closely resemble those of the fruit and foliage of the wild fig (*Ficus* species) their favourite fruit tree, that a flight of them may be concealed amongst its branches without being seen; on any one's approaching the tree, the birds, being fully aware of the protection which their colours afford them, remain perfectly motionless. A shot, however, fired into the tree will send them flying in all directions. The plumage of this pigeon consists of beautiful shades of green, with red beak and legs; these colours blend admirably with those of the wild fig. The tree is an ever-green, and bears fruit all the year round, thus continually affording the green wood-pigeon not only food but also protection; hence it is the home of these birds.

The favourite food of that superbly arrayed bird, the lory (*Turacus albo-cristatus*) are the berries of the wild vine. Like the plumage of the lory, the foliage of this climber varies considerably in its shades of green, and the berries alter in colour as they ripen from light red to crimson, and ultimately to almost a black colour, while the twining stems of the plant are of a pale grey or white. These colours being the same as those of the lory, blend and harmonize with them admirably, rendering the bird protection from her foes. This climber, with its long twining branches, covers large patches of the forest, it is seldom without fruit, and forms the favourite haunt of the lory; it is there they may be found if you seek diligently, but they are by no means conspicuous, hidden amongst its sheltering leaves.

In the ostrich (*Struthio Camelus*) protective colour is of the greatest importance; the indistinct grey colours of the female are wonderfully adapted for purposes of concealment, which in so large a bird (especially during the season of incubation) are of infinite service to her. These birds, while upon their nests, do not erect their long necks at all, but place them at full length in front of them upon the ground; neither are their large white feathers conspicuous, for they rest upon the earth also, and are partly hidden by the dark ones; at all times the grey inconspicuous colour of the female ostrich might easily be overlooked, or mistaken for some other object, such for instance as an ant-hill, so common on the plains of this country. It will not, however, be imagined that the male ostrich in his splendid white feathers and jet black coat, is equally well adapted for purposes of concealment, and that together with the female he shares the duties of incubation; such, however is really the case. No sooner has the day ended and the darkness fairly set in than you will find the male upon the nest, while the female is away in search of food, from whence she will not return until daylight has rendered the male a conspicuous object. Her approach to the nest will be conducted in a most cunning and careful manner, for well she knows that the keen and watchful eye of the wild Bushman (her deadliest foe) may be upon her, and that every precaution is absolutely necessary. In wide circles therefore and apparently in the most careless and unconcerned manner, the female ostrich will feed round her nest, never once looking towards it, but gradually approaching nearer and nearer to it, by diminishing each circle as she walks round, until at length, her perambulations have brought her to within a yard or so of the nest, when the two birds will suddenly and rapidly change places, the male walking swiftly away, and not remaining in the vicinity of the nest during the day. The wonderful rapidity with which the change is effected is perfectly astonishing, and it is impossible to see the exact manner in which it is done, so swiftly do they change places.

The young of the ostrich have similar habits to those of the pheasant and partridge; on the approach of an enemy they scatter and hide in the long grasses, where they are left by the parent birds until such time as the

danger has passed over. The rounded form and mottled coat of the young ostrich, as it lies hidden and motionless in the grass, is a capital imitation of the small black ant-heaps, which are by no means uncommon in the grassy localities, or on the plains where these birds have their nests; this remark, however, has reference to the very young birds only, for they quickly become swift-footed, and soon learn to follow the parent birds.

Land birds are for the most part coloured to match the country they inhabit, some of them however possess conspicuous markings (*indicative colours*) which are of great service to them in their flight, enabling them if disturbed (especially during the night) to keep together. If, however, they are not in possession of indicative colours (such as white beneath the wings, &c.), they will probably utter some peculiar note or frequent cry which will answer the same purpose, like that of the fern owl, for instance.

The stanley crane (*Tetrapteryx paradisea*) is beautifully indistinct, as it stands with its long neck gracefully folded beneath its wing, roosting upon one leg in the broad shallow waters of the rivers and "pans" of this country. The different leaden shades of colour pertaining to this bird, are precisely those of fresh water, a pale slatey-blue; there could not be a closer resemblance. These shades of blue are not so deep as those of the ocean, which at all times, on account of its great depth, and cleanness reflects the sky more distinctly than do rivers and "pans" of fresh water, and the stanley crane being a fresh water bird is admirably adapted to escape notice in the station which it has to fill.

The brilliant colours of butterflies are in all cases I believe of a protective nature, for like the *Nectarinia*, or various species of sunbirds, their most unguarded moments are those employed amongst the flowers in search of food. Is is then that most species of butterflies may be taken by the finger and thumb, so utterly devoid are they of all else, save the pleasures of imbibing nectar from their favourite flowers. It might be said of these little creatures, that they are determined epicures, but at the same time it must be remembered that butterflies are aware of the protective nature of their colours, and on them they rely in a great measure for safety whilst feeding amongst the flowers.

Deceptive colour.—There is a peculiar purpose to which colours are applied by certain creatures, which might appropriately be termed *deceptive*; it is nearly allied to mimicry in its nature, but different in its purposes, as mimicry in all cases is permanent, and likewise of a protective nature, whereas deceptive colour is ever changeable and uncertain, and assumed not for protection nor yet for ornamentation, but purely for purposes of misleading and deceiving.

The small grey mottled chameleon, apparently so quiet and harmless during the day sitting for hours together without moving upon some leafless, or scrubby shrub, following suit to its colour, is a very different creature in the gloaming or twilight, when the moths and other night-flying insects are abroad. It is then that the chameleon climbs to the summit of a branch, where he changes his sombre coat by turning *white* and by this means becoming a remarkably conspicuous object, in fact passing himself off as a flower, which of all others, is the easiest to be distinguished in the dimness of the evening twilight, thus becoming a "delusion and snare" to night-flying insects. Moreover I fully believe (although I am not prepared to state it as a fact) that in this position the chameleon opens its mouth, exhibiting its bright yellow colours as a decoy to insects that are passing by, for the purpose of tempting them into its mouth, and thus securing its prey by a cunning stratagem. It is well known that the centres or tubes of many white flowers are usually of a yellow hue, or otherwise the stamens are of this colour, consequently the yellow mouth of the chameleon would more than any other colour be calculated to mislead and deceive the insect tribes. It is well known that the chameleon is a dull and sluggish reptile, creeping along at a snail's pace, and unable to travel with any degree of rapidity from one locality to another in search of flowering plants, where naturally insects would abound; neither do I imagine, from what I have observed of the creature's common habits, that it ever does so; on the contrary, it may usually be found near the same spot, not frequenting the places where flowers most abound, but (as I have already stated) perched upon some tall shrub or tree following suit to its surroundings, with here and there a few patches of mottled green upon its otherwise grey, and inconspicuous body,

and in such stations the chameleon may be seen for months together. Now if my conjecture be correct this would exactly suit its natural habits, there would be no necessity for its going in search of flowers, for the purpose of capturing insects; the creature in its white disguise would be in itself a sufficient attraction to all night-flying moths or beetles. The strongest argument in my favour however, is that it is entirely contrary to the usual economy of nature, that the bright yellow mouth and throat of the chameleon, which must have been acquired through long ages of natural selection, is merely a purpose less object, a "*lusus naturæ*." It must not however be imagined that I am endeavouring to make out a wondrous tale; I have already stated that I am unable to *prove* that the chameleon actually does practice the habit. I am merely in search of the truth; these remarks may lead others who have time and opportunity to investigate the matter thoroughly. There is one thing that I am bound to state which is somewhat against my arguments, and this is, that the eye of the chameleon is not adapted for night-work. It is an exceedingly small squinting eye, there is no end of "speculation" in the bright twinkle of this little rolling telescope, as it is directed by its owner to various quarters, but it is not a night-seeing eye. This however, would not pre-"vent the creature from receiving insects that came unbidden to its trap." That the chameleon is in the habit of capturing flies and other insects during the day (especially in confinement) I am fully aware, but this is not I imagine the manner in which they obtain their principal supplies of food, otherwise they would be in the habit of frequenting flowering plants, where insects would at all times be more numerous. I must not omit mentioning another peculiar habit pertaining to the chameleon, which is not perhaps generally known. When the creature is seized by an enemy, it utters a low hissing sound like that of an adder. This peculiar snake-like sound is somewhat startling and in itself sufficiently alarming to induce its enemies to drop it at once. A chameleon will, however, if alarmed detach itself from a branch and dropping to the earth will thus baffle its foe, not fearing the consequence of its fall, for in its passage downwards, it has the power of suddenly inflating its body, more or less, according to the height from which

it has precipitated itself. By this ingenious contrivance, the body of the chameleon is rendered light and boyant and the force of its fall is broken, and like an india-rubber ball coming in contact with any hard substance, it would rebound and the creature would receive no injury.

The green chameleon of Griqualand West has its habitat in the large "thorn trees," (*Acacia giraffæ* and *heteracantha*) which abound in that country. As far as my observation goes, with the exception of a few small rotate markings of pale grey, I have never found this species to be of any other colour but green. This chameleon being an inhabitant of the ever-green *acacia* tree, other colours would be of no advantage to it, it has however the power of assuming innumerable shades of green, changing from the deepest hues, to the palest shades, but at the same time never departing from this colour. Like its congener, the mottled grey chameleon of the coast (above mentioned) it has a similar coloured yellow mouth and throat, but in addition to these, the exterior of its throat or neck is also coloured in striated lines of orange and yellow, with a slight admixture of green, adding to it another charm and rendering the neck of this species not unlike the tube of a flower in its colour. It will be remembered that the blossoms of the above-mentioned acacia tree are yellow, they are of precisely the same shades as the mouth of the chameleon. These acacia trees blossom once a year only, and continue in flower but for a brief space, they are very sweetly scented, and on this account clouds of insects of various kinds frequent them during the season of their blossom, this period however, as I have before stated, is so brief in its continuation that to mimic the colour of the acacia blossom would be of infinite service to the chameleon, as it would in all probability be the means of attracting the different species of insects which frequent these trees, and of leading them to the yellow mouth of their enemy, or in other words, to the open sepulchre prepared for their reception. The green chameleon is much larger than the grey mottled species of the coast, but on account of its colours resembling at all times those of the *acacia* trees, and changing like the trees at different seasons of the year to different shades of green, the creature is but rarely seen, and is comparatively safe

from the ravages of its enemies, which consist of hawks, owls, snakes &c.

There is another South African creature with habits very similar to those of the chameleon, ; I refer to a species of tree frog, or more properly speaking "a flower frog" (*Hyperolius*). This small frog is invariably found to be of precisely the same shades of colour asthe flowers it inhabits, and it possesses the gift of acquiring different hues, even more rapidly than the chamelion. I have changed this frog from flower to flower and found it follow suit to them all. Its favourite haunt is always beneath the sheltering petals of some large blossom, when it lies in wait for its prey. The mouth of this species is beautifully variegated in soft shades of rose colour, and I am inclined to believe that like the chameleon, this frog makes use of its pretty mouth as a decoy for insects, It would not be difficult while hiding in a flower for this little creature, on the approach of an insect to open its rosy mouth, thereby rendering the blossom more attractive to the unsuspecting moth or butterfly.

The "Flower Spider" also assumes deceptive colours, as it hides beneath the petals of a flower, ready to spring forth upon its prey. This spider will always be found to be of the same colour as the flowers in which it occurs, and in all probability possesses the power of changing its hues, like the above-mentioned creatures. A lizard (*zonurus* species) not uncommon on the plains of Griqualand West has also the power of altering its colours to suit the locality in which it is found. This lizard which subsists chiefly upon butterflies and locusts, lies in wait for its prey, amongst the low-flowering shrubs that are scattered upon the plains of Griqualand. Its prevailing colour is a pale reddish-brown or grey, according to the colour of the soil in the locality in which it occurs ; it has however large irregular spots or markings, which cover a great portion of its body, gradually diminishing as they approach the extremity of the tail, and these patches vary in colour according to the nature of the flowers and foliage in which the lizard is found. At times they will be of a brilliant red or magenta colour, when the creature will be extremely handsome, or of a fine yellow or green beautifully blending with lighter or darker shades of whatever the predominant colour may

be of the plants they are hiding amongst, or lying in wait for their prey. On my first acquaintance with this lizard I was ignorant of the power it possessed of changing its colour like the chameleon, believing that each individual (like many of our South-African grasshoppers) was coloured to suit the locality it inhabited. Being charmed one day, however, with the fine magenta colours of one of these lizards, I captured it for the purpose of taking its portrait, and not wishing to injure the little fellow I tied it to a flower vase and left it on a table which was covered with a brown cloth. Great was my surprise on returning after a short absence, to find all its beauties flown, all its brilliant colours departed, and a dingy brown usurping their place; in fact the colour of the old brown table cloth, which the creature had imitated.

The various species of *Mesembryanthemum* which are dispersed over the plains of Griqualand West, form the favourite hunting ground of these lizards, and the wonderful manner in which the colours of the lizards blend and harmonize with the blossoms and foliage of the different species of these plants, is both striking and remarkable. They hunt in pairs, and are fond of flowering plants on account of the butterflies which frequent them. The "painted lady" (*Pyrameis Cardui*) is one of their choice morsels. The lizards are well aware of the peculiar habit of this butterfly, which, if disturbed, will, after flying away, return again and again to the same spot, and they will patiently lie in wait amongst the shrubs and grasses, abiding their time, until the return of the butterfly. In hunting they assist each other.

The gaily painted "China spider" (?) as it is commonly called in South Africa, is another example of deceptive colour. This spider has not, however, the power of changing its hues, as in the above-mentioned cases, and its colours differ from mimicry in not imitating any one particular object, also in not being assumed for purposes of self-preservation. This creature is altogether a fraud, and its gay colours are put on purely with the intention of deceiving and misleading unwary insects.

By the edge of a forest, or among low flowering shrubs in sheltered nooks and corners, the China spider

takes up its abode, carefully building its nest, and spreading its golden meshes over a considerable portion of the low shrubs which it inhabits. The webs of this "Gay deceiver" are sufficiently strong to detain the largest butterfly. In the centre of this net the spider takes up its position; unlike most species of its tribe, there is on its part no hiding or mimicking obscure knots of wood thorns, &c., for the sake of protection; on the contrary the China spider is conspicuous in being gaily painted in a bright yellow ground colour, ornamented by undulating lines and shades, as well as other makings of various brilliant hues. The long spreading limbs of this spider are also ornamentally marked, and coloured, they are not unlike the narrow petals or stameus of certain flowers, and thus arrayed, it is evidently the intention of this creature to be mistaken for a flower in full blossom, thus forming a trap for butterflies, and other nectar-loving insects, a clear case of—

"Will you walk into my parlour?
"Said the spider to the fly."

On the approach of an insect the China spider will cunningly jerk its net, causing it to vibrate rapidly up and down, rendering its form indistinct, and imitating a flower quivering in the breeze or quietly shaking in the wind, and in this manner completing the delusion and snare, which is prepared for unsuspecting insects. The bright golden appearance of this spider web may be discerned from a considerable distance, but woe betide the misguided creatures led thither by the glare and the stratagems of the China spider.

Mimicry.—I am of opinion that the ocelli or eye-like markings on the wings of certain butterflies and moths, are also somewhat deceptive in their nature, although properly speaking they come under the head of mimicry as they are assumed for the purpose of self-preservation, and are in reality intended to represent *bonâ fide* "eyes" of various kinds imitated for the express purpose of scaring away predaceous creatures. The influence which an eye possesses, when steadily fixed upon any creature is well known; even the lion may be defied by the stern gaze of a brave hunter. Which of us for instance will not quail before the nest of a wasp? when these small creatures turn and face us with their slender antennæ

waving in defiance, and their small fierce wicked eyes fixed upon us as much as to say "come nearer if you dare" and we retire quietly deeming discretion to be the best part of valour. Even on a crab the eye has great power, as you will see by the following anecdote. A friend of mine, Mr. A. Murray, while fishing one day in a small stream perceived a large crab on the opposite bank; it was steadily gazing across the stream on some small fish the angler had taken. After a short interval the crab disappeared, and crossing the river, was seen to be making its way stealthily towards the fish, the moment however that the crab perceived Mr. Murray's eyes fixed upon it, a retreat was at once commenced towards the river, but when his eye was withdrawn, the creature again came forward and this occurred several times; until at length deeming that the crab had earned a fish by its cunning and perseverance, Mr. Murray allowed it to steal one, which it did in all haste, hurrying off to the river with its prize; it was a clever case of theft on the part of the crab, at the same time illustrating the great power which an eye possesses, even over a crustaceous creature.

Now after this long digression, I must return to my subject, my only apology being that I have not wandered beyond the limits of natural history.

In the *Satyridæ*, a family of dun or combre coloured butterflies, usually found to inhabit low woodland, or grassy localities, the *ocelli* or ring-like markings, are extremely common, many of them are capital representations of eyes, even the pupil with the light thrown upon it, being well defined by a minute white spot or transparent tissue. Many of these eyes are very keen and wasp-like in their expressions, others are indistinct like the eyes of hawk-flies or spiders. I have, however, never studied them with a view to discovering what eyes they chiefly resemble. The different species of *Satyridæ* are not rapid in flight, but weak and uncertain, seldom flying to any great height or distance, but dancing about low shrubs, settling upon the earth, and roosting among old leaves, or half-dried stems and foliage, which resemble their own sombre colours, where consequently they would become very inconspicuous excepting always the peculiar *ocelli* upon their wings, which at all times, if exposed, have a remarkable appearance, and I am inclined

to think that any creature carelessly approaching them without the knowledge of their pertaining to the wings of a butterfly, and mistaking them for the eyes of an enemy lying in wait for its prey, would probably take its departure at once, being scared away from the locality altogether.

Moths with *ocelli* upon their wings are by no means uncommon. It is well known that the ordinary habit of a moth during the day is to retire or hide itself in dark shady places, where often it is scarcely possible to trace the general outline of its form, so closely will it resemble the fallen or dried leaves and branches by which it is usually surrounded. The large staring eye-like rings or *ocelli*, however on the hind wings of many species of large moths, if not concealed by the fore wing, are at all times remarkably conspicuous objects, as they are considerably larger than the *ocelli* on the wings of butterflies, and consequently more calculated to alarm predatory creatures prowling about in search of food, such as birds, toads, spiders, &c., especially if the moth by a sudden movement of the fore wing left the *ocelli* exposed, and apparently fixed upon them, from the indistinct mass of shadowy foliage in which it had concealed itself. A fit abode, not only for moths, but predatory creatures as well; for it will be remembered that such creatures do not only prey upon the insect tribes, but likewise upon each other. The small bird or spider might imagine the *ocelli* on the wings of a moth or butterfly, to be the yellow-ringed eyes of a toad, which in fact some of them greatly resemble, especially the eyes of the large mottled green forest toad, which is commonly found along the coast; the toad would be the enemy of the small bird or spider; and on the other hand, the toad might itself imagine the *ocelli* to be the eyes of a snake, its deadliest foe; in this manner the moth or butterfly would find immunity and the *ocelli* be of the greatest service to it.

A large brown moth (*Cyligramma Latona*) which is widely dispersed in South Africa, has on the centre of its fore wings, very handsome *ocelli* or eye-like markings; there is even much expression in these peculiar eyes, and the light upon them, is well defined by a wedge-shaped stripe passing just above the pupil. If this moth is placed with its head downwards, and examined critically,

with a view to discovering what it resembles, it will readily be admitted to be exceedingly owl-like in its appearance, especially in the expression of its eyes; the small projecting head of the moth would resemble the beak of the bird, and the cream-coloured wavy stripe which passes round the *ocelli*, would form the division between the short feathers which cover the face of an owl, and the longer ones which stand erect, forming the frill, beyond the cream coloured stripe above mentioned. The markings on the wings of the moth are exceedingly feather-like and curious, and the upright bars across the apex of the wing are somewhat ear-like in form, moreover this moth has a peculiar habit of causing its wings to tremble, or vibrate, which at once gives an exceedingly weird and fierce expression to this fanciful resemblance of the face of an owl or bat, which the general form of this handsome moth presents.

I might prolong this paper to a greater length, but perhaps for the time being, it is sufficient for the purposes for which it was written; first, that of proving from ocular demonstration to a certain extent the truth of Mr. Darwin's Theory of "Female Selection," and secondly that of further illustrating the peculiarities to which colour in its manifold services is applied in nature, and the all-important influence which it has on the lives and habits of various creatures.

V. *The Limestones of the Colony.*—By W. Prosser, F.G.S.

[Read, 30th January, 1878.]

Lime occupies a prominent position among the economic products of every civilized land or district, and although clay or puddled earth partly supplies the place of mortar in the erection of many buildings in Africa.

Still in most countries lime as the cementing agent in mortar, is the essential element in (mixing up) the manufacture of cement. The Colony is not devoid of this useful substance, lime. Limestone occurs here in two forms, what may be called ancient and modern, stratified and unstratified, in its original position *in situ*, or as a secondary or recent production.

Notes on the Limestones of some parts of the Cape Colony.

Mr. Andrew Geddes Bain referring to the limestones of the Cape Colony remarks as follows: "Very extensive deposits of calcareous tufa are found along the Coast; these are principally formed of the detritus of the tertiary formation which I have no doubt at a former period fringed the Coast. In some places it attains a thickness of one hundred feet and contains embedded shells of the common land snails in great abundance, as well as vegetable remains. At Point Aguilhas the new lighthouse (1851) has been built of this rock, and it is generally used for lime burning. Thin beds of calcareous tufa are always found overlying the reptilian strata in all parts of the interior, and are invariably used by the inhabitants for lime, there being no regular stratified limestone in South Africa."—*Bain's Geol. p.p.* 190 to 191.

It is to be regretted that Mr. Bain did not particularize a little as to the localities where this tertiary detritus could be seen. Judging by the kinds of organic remains which he states it contains, shells from our

present seas, that by the time tertiary he meant recent formations or possibly post tertiary forms. These remarks prove what a keen observer Mr. Bain was. But although there may not have been beds of regular stratified limestone exposed in the Cape Colony in Mr. Bain's time, yet there are some deposits of this kind which are now worthy of notice if only from a commercial point of view. In the following paper the writer will only treat of what he has himself examined, in that tract of country reaching from Cape Town along the Beaufort West Railway to the New Rush in the Gouph, a distance of about 300 miles.

The Coast limestone to which Mr. Bain has referred may be examined in the chalky-looking hill known as Gallows Hill, which is situated just in front of the Military Powder Magazine off the Somerset Road, Cape Town. The limestone composing this low hill appears, at first sight to be nodular and superficial, but on closer examination is found to be semi-massive and at least ten or twenty yards in thickness.

It burns into fair limestone. Judging by its appearance its formation is of a very recent date. The only feature about it which requires special notice is its pipe or tubular character. A careful inspection of its section shows that it has been built up in layers, or platforms, which are connected together by means of columnar pieces of the same tufaceous material, as if the stalagmitic layer had been suddenly covered by sand, transported possibly by the wind. Water impregnated with lime rising through the sand would form a tube, and along the inner surface of this tube, commencing at the bottom, stalagmitic matter would be deposited. After the sand had become indurated by the admixture of calcareous substance a terrace having been formed, the surface of the terrace would be covered with another stalagmitic layer and so on until a hillock of some 20 or 30 feet has been formed of alternate layers of lime and sand.

As the hardened sand contains abundant remains of modern shells either whole or in a commented state, there can be no doubt but that Gallows Hill is of very late formation.

It is certainly not tertiary. A very excellent deposite of limestone occurs near the village of Worcester. So pure is this that it may be called marble. While referring

to marble it would be interesting to learn whence came the marble slabs which one sees so often in old houses in Cape Town. It is very unlikely to have come from the Worcester quarry, if for no other reason, than, that its stone is not as a rule fissile, it will not cleave as it is not bedded. The Worcester marble is almost one solid homogeneous mass as you will perceive from the sample before you.

It is found in the metamorphic rocks at a distance of about a mile to the north of the Worcester Railway station. It is unfossiliferous, and was, in all probability, formed by the deposition of calcareous matter by the agency of water in a fissure in the rock, or might have been at one time a superficial deposite which became covered over with other rock layers, and in common with them was metamorphosed into its present highly crystallized state. The deposite, which is of very limited extent, dips with the bedding of the surrounding rock towards the south at an angle of above 30°—This high inclination constantly increases the depth from the surface, and thus renders its working more and more expensive. When the writer examined the locality in 1876 the greatest thickness of the limestone was three yards, thinning to nothing at both ends, in a length of about twenty yards, and with a "top" of superincumbent strata of about twelve yards. The most economical way of working it would be by tunnelling.

In the construction of the Beaufort West Extension Railway some beds of stratified limestone have been exposed. The thickest and most calcareous of these occurs near the mouth of the long tunnel near the summit of the Hex River Mountains. The bed in question is four feet deep, and is a component part of the Devonian Strata comprising the Hex River Mountain series. It has an additional charm in being highly fossiliferous; in fact it often contains a larger proportion of organic than of inorganic matter. Large winged *spirifera orthes, leptænæ* and *crinoids* abound in it.

It burns into a very strong lime, which has the additional value of setting under water. This bed, of limestone together with a few less important bands which accompany it, may be considered as the typical fossiliferous rock of the Devonian series of South Africa. It crops out in many parts along these hills, and is no

doubt continuous over large areas; for no fact is better established in connection with the stratification of rocks than the constancy of their beds of fossiliferous limestone. Such a band accompanies the lignites of Devonshire. The Silurian limestone of the Caradoc series extends over large areas of North Wales, Salop and Hereford. The lower Silurian band is also very persistent over much of the Lake District of Cumberland, and is well represented at Coniston. But perhaps, excepting the chalk beds of the cretaceous series, the most highly developed and most marked strata of limestone are those of the carboniferous or mountain limestone—so called because they form mountain masses. Both in England, Ireland and on the Continent of Europe the Lias Limestones are well developed in regular beds of limestone. The organic remains of any system of rocks are always best seen in its limestones, for the simple reason that the abundance of lime enabled the animals to form their tests.

In the specimens before us of this limestone we have fossil remains with thick perfect shells. On the contrary shells which are found in sandstones either have no test left, the impression only being visible, or the shell is very thin. This is owing to the absence of the calcareous matter which was necessary to form their shell. The fossiliferous limestone beds referred to above, do not crop out over large areas, because the superincumbent thick-bedded sandstones cover them, it is only in vertical escarpments of great height, like those of the Hex River Mountains, that they can be studied, as they are hidden elsewhere by the folds of the superimposed sandstones.

But though hidden from view the existence of these stones of Devonian limestones under nearly all the Karroo is proved by the presence of superficial deposites of tufa. The Devonian beds have not been examined with the care that they deserve, a rich harvest of new fossils may yet be obtained from them. Nor are the calcareous strata of the Devonian rocks confined to limited areas. Mr. Wylie in his report on great Namaqualand names several places in that country where limestone beds crop out on the face of many of the tabular hills. It is a somewhat curious coincidence that the Hex River Mountain limestone and the Namaqualand beds are only to be seen on vertical escarpments. Considerable quantities of limestone appear in another horizon that is immediately above the felspathic trap in the equivalent of the

mountain limestone of Europe. These can be advantageously studied in that line of country reaching from Rietfontein in the Karoo, to Geelbeck River—the farms of Mr. Roux of Rietfontein, Mr. Greef of Zoute Kloof, Johannes Meiring's, J. Jacobus Nel's, Lerwe Jacobs of Fhezefontein and their adjoining farms, in all an area of several hundred square miles, present in many of the rock sections large nodular masses of limestone. They are of two kinds, one deposited in pot-boles, the longer axes of which lie transversely to the bedding of the rocks, and another which lies conformably to the stratification. The first is very dark-coloured, nearly black, and very brittle. This has been successfully burnt on the Zoute Kloof Road near the Buffel's River, for more than a year, for railway purposes. It forms excellent lime, possessing slightly hydraulic properties, which has been used in the construction of the bridges, culverts, and cottages of the railway from Buffel's River to Grootfontein. It is also being carried still further, for the masonry of the next district, and to a distance of not less than forty miles from the kilns. In the same district, but at a higher geological horizon, in the same carboniferous beds, are irregular, nodular bands of limestone, lying in a parallel direction with the surrounding sandstone strata. They are best seen between Buffel's and Dwyka Rivers. As the latter is reached the nodular masses occur at such short intervals as to almost have the appearance of an irregular stratified bed of limestone. But these deposits are unfossiliferous, which is additional evidence that they were not formed as stratified beds forming important parts of a great deposit, but that they owed their origin to an extraneous cause which can best be explained in connection with the surface or tufaceous limestone, which is abundant over much of the district in question in this Colony, which is also the chief source of the lime of many parts of India. Tufaceous limestone is found all over the Karoo and Gouph. It not unfrequently covers the surface of the ground at times forming low-rounded eminences, at other times, lining the sides of watercourses, and more rarely filling up shallow basins near the bottoms of valleys. But in no case have we seen any tufa in any part of the country where, if rocks did not lie above, springs did not issue from the Devonian series of rocks, thus possibly indicating that

the Devonian limestone described above was the source of the mineral. In thickness the deposit varies from a thin film to two or three feet, but its characteristic mineralogical characteristics and general appearance are everywhere constant.

Again, it always lies on the face of the ground, showing that it is of recent formation. Its deposition is a fact quite recent, and is being carried on at the present day. As a rule it forms excellent lime when burnt, still we have some instances where the formation seemed to have been too new, and it would not form lime sufficiently good to be used as mortar, although it would be very useful as manure. But whence comes the calcareous matter? Carbonate of lime is slightly soluble in water; it is also separable from it, both by the action of gravity and by evapouration, other things being equal the quantity of calcareous matter deposited is directly according to the volume of water. The higher the temperature of the atmosphere the more rapid would be the deposition of the surface stratum. As the percentage of lime in water is only small, thick layers of tufa point to long periods of action.

Nearly all tufaceous deposits contain embedded pebbles. At Fliege Fontein, near Lowe Jacob's house, a considerable mass of this substance contains so many stones as to give it the aspect of pudding stone. The reason of this is obvious, whatever materials lay in the course of the limey stream, became encrusted with the stalagmitic matter. But we digress—wherever a spring containing soluble mineral matter appears, this matter is deposited as a crust round its mouth, and on the surfaces of the rocky walls forming the sides of the fissure through which it flows. This is equally the case whether the stream issues out of the summit of a hill, or at the bottom of a valley. In time the encrusting substance accumulates to such an extent as to close the aperture, the flow of water then ceases, and the only indication left of the former existence of the fountain is a smaller or larger expanse of tufa. Numerous spots in now waterless wastes were once refreshed by such springs. Gradually the mouth of the fountain became more and more confined by the deposited matter, until at length the weight of the superimposed crust effectually sealed the last trickling of the once stronger stream, or weakened its current to such

an extent as to make it too insignificant to be noticed. Break the seal and the precious liquid flows afresh; remove the surface limestone where it appears highest and the stream will again burst forth. This has been successfully carried out in many parts of the Karoo. Two notable instances occur between the Draai and Constable, one a strong spring on Mr. Plessis' farm, and another near Crabchat. And it is worthy of notice that not a drop of water could be obtained in the whole of that district, which is twenty miles long, until these long-lost springs had been found again.

We are persuaded that a great quantity of water imprisoned by such means may be liberated, by carrying out the above named plan.

Among the most recent and extensive tufaceous deposits is that at Blood River in the Gouph. It occupies a considerable area, filling a basin of nearly a mile in circumference.

It lies in the present course of the Blood River—only a torrential stream—but there are undoubted evidences that this was not always the case. This bed of tufa is some yards in depth, and it has doubtless been formed by the gradual encrustation from the waters of a calcareous spring, with this speciality that the outlet of the vley got filled up first. The waters were then banked up into a lake, the water of which left a crystalline coat at the bottom, this coat got gradually thicker and thicker, until it attained its present depth, the dam at the mouth rising with the other parts. In time the interstices through which the water reached the surface got filled up also, and the whole operation ceased. Wherever this crust has been broken small streams of hard water have issued out from beneath the tufa. There is little doubt but that a strong spring may yet be recovered here.

Intelligent Boers are thoroughly alive to the recovery of old fountains from under beds of tufa. And I have not yet seen one such effort to totally fail. These tufaceous deposits show that there is an intimate union between the present and the past. There is nothing lost in nature; decomposition means reorganization in another form or in another place. And now (May) 1877, that the country is suffering so severely from lack of water, it behoves us to avail ourselves of any information which tends to throw any light as to how the supply might be increased.

VI *The Petrography of Table Mountain Valley.**—By Dr. Shaw.

[Read the 29th May, 1878.]

The Geology of Table Mountain valley has been described by various writers.

There are four formations in the Table Mountain valley: The granite, clayslate what has come to be named the Table Mountain sandstone, and the fourth a less conspicuous trap rock, which penetrates the granite and clayslate. The oldest member of the series is the clayslate. The Table Mountain sandstone is the youngest, and lies unconformably on the clayslate on Devil's Peak, and on that part of Table Mountain next to it. On the rest of Table Mountain the sandstone lies on the granite. On Lion's Head it lies also on the granite. The dip of the clayslate is more or less vertical; its strike is S.E. to N.W. No fossils have been found in either the clayslate or the Table Mountain sandstone.

The general question of the age of these rocks was discussed by Mr. Prosser at a late meeting of the Philosophical Society, but until fossils are found in the Table Mountain sandstone, and in the clayslate, nothing further can be added of scientific value to what has been written by Bain, Wiley, Rubidge, Clarke, and Hochstetter.

While the geology of Table Mountain and the greater part of the colony has been described by various men, as Dr. Cohen very justly remarks, nothing has been published on the petrography of our rocks. The desirability of an exact and correct nomenclature must be evident;

*Being an abstract with remarks on Professor Cohen's papers published in the "Newen Jahrbuch für Mineralogie, &c., 1874," by Dr. John Shaw, F.G.S., F.L.S., &c.

but in the case of South Africa where so much has been done by amateur geologists, it is a necessity. The eruptive rock, which penetrates in the form of a dyke, the granite and clayslate of Lion's Head and Devil's Peak has been variously named a trap, greenstone, basalt, diorite, trachite, dolorite; and before the analysis of Dr. Cohen only one attempt by Itier was made to analyse it. This is an example of the indefinite and unsatisfactory character of the nomenclature of South African rocks.

I.—*The Granite Formation.*

The granite crops up at the north part of Table Mountain, especially at Platteklip, in the Kloof, on the beach between the Round House and Sea Point, and on the slopes of Lion's Head. The Kloof quarry gives a good exposure for observing its general character.

The granite is a very rapidly decaying one. This is best shown at the north-west end of Table Mountain, where numerous ruts may be seen in it, some 100 feet. deep. Small pillars occur everywhere there. The granite shows very much the same character to the junction with the slate. It is very coarsely grained; the felspar being especially conspicuous, and projecting as in a porphyry. The following is Dr. Cohen's diagnosis of the Granite condensed.

'Crystals of felspar are sometimes 9 centimetres in length, and 3½ centimetres in breadth. The orthoclase is pure white with brilliant facets, showing many fine silver white scales. The large crystals of orthoclase are mostly in the form of Karlsbad twins. Frequently there are quartz grains in the Orthoclase as in graphic granite. There are small greenish particles in the orthoclase. These are plagioclase, or triclinic felspar. The felspar of the Table Mountain granite, however, is nearly altogether orthoclase.

'The quartz comes next in importance to the felspar. It is greyish and glossy like fat, in isolated crystals, and not so often in large parts together. Dark, tobacco-brown mica, in scales, in aggregate masses or solitary, sometimes in thick hexagonal leaves, occurs. It plays, however, an inferior part.

'Pinite plays a far greater part. It is mixed up in the

rock in considerable quantities The granite might be well called a pinite-granite.

'The pinite is dense, very soft, of dull brilliancy, and splinty fracture; mostly greyish-green in colour, seldom light bluish-grey. Often there are outline crystals of the well-known form of the pinite of Auvergne, but the larger crystals have the kernel changed into brown or green mica.

'The granite of Table Mountain seldom goes into gangs, or dykes, but is generally in mass, as at Platteklip.

'Some erupted gangs with aggregates of tourmaline crystals are to be perceived; in these, however, the orthoclase striae, which appear as in porphyry, are wanting. This variety is to be found at Camps Bay.

'Besides these constituents the thin transparent slice reveals apatite and titanite, but in very small quantities. Otherwise the rock reveals only granitic indications.'

The thorough character of this diagnosis will be generally admitted. The granite throughout the Table Mountain valley varies as regards the greater or less prominence of certain constituents. It is much more porphyritic on the neck of the Kloof and onwards to Sea Point, than at Platteklip, and in the quarries on the lower Kloof Road. Some of it has a decided gneissic appearance, but there is no trace of the foliation usually developed in metamorphic rocks. The petrographist may be often mistaken by mere hand specimens, while the physical geologist, taking the whole field, observes one variety gradually passing into another, and different although allied forms of crystallization appearing in the place of the usual forms. The explanation of this may be given in Ramsay's words that granite itself has been subjected to a certain extent to metamorphosis by pressure and otherwise during its crystallization from a molten to a solid condition.

II.—*Trap.*

The diabase forms a gang or dyke in strongly decomposed granite on the south-east foot of the Lion's Head, immediately over the saddle of the Kloof between Table Mountain and Lion's Head. Near the Clifton Hotel there is again Diabase, apparently a continuation of the

first dyke; although the thickness of the former is only 120 centimetres, and of the latter 700 centimetres. The strike is from W.N.W. to E.S.E.

Similar dykes are described by Hochstetter near Rocklands Point, between Simon's Bay and Millers Point; also in the granite. Krauss has observed one on the Devil's Peak penetrating the clayslate. There are also the dykes Captain Basil Hall mentions in the granite in Simon's Bay, called Noah's Ark. This, however, may be identical with Hochstetter's dyke.

The following is Dr. Cohen's description of the rock: "The dyke is sharply defined from the granite without any appearance of connection. It is for the most part extraordinarily decomposed. The scaling off of the nodules is very fully shown. By breaking, one occasionally gets a fresh kernel.

"The decomposed parts show a mixture of soft red, green, and yellowish scales. The fresh kernel consists of a tough, fine-grained, greenish-black rock, in which, with a magnifying glass, numerous small felspar crystals are seen, with brilliant facets.

"In the slice, the rock gives a splendid picture, and indicates on the very first view that it is a typical diabase. The Table Mountain diabase consists of grains of angite, plagioclase, and magnetic iron. All parts under the microscope appear fresh and pure. Occupying a very subordinate place are green leaves of chlorite and dark-brown scales of mica.

"The analysis of the Table Mountain Diabase, according to Hillebrand gives:—

Plagioclase	40
Angite	30
Magnetic iron	13
Chlorite	9
And a kind of Felspar	8
	100

The chemical analysis is, according to the same investigator:—

Silica	52·41
Alumina	13·04
Oxide of iron	9·46
Sesqui-oxide of iron	8·35
Lime	8·36
Magnesia	3·50
Potash	1·23
Soda	3·24
Water	1·26
	100·85

Remarks.—When Dr. Cohen was in this colony I had the great pleasure and good fortune to spend some weeks with him in different parts of the colony, and in the Diamond-fields, and he was then under the impression that the trap rocks of South Africa would prove very interesting in deciding some points in the classification of erupted rocks. It is satisfactory to know that they are typical diabase, as proved by chemical and microscopical examination. I need not say that a name is only significant when accompanied by an analysis and description of the rock, or whatever else is quoted by name for the first time, and I am glad to have been able to publish, for our philosophical transactions, Dr. Cohen's conclusions founded on the first published Petrographic Analysis of South African Rocks.

The dyke referred to by Dr. Cohen passes right through the Lion's Head and is traceable to Table Mountain on the Kloof flank. It does not however penetrate the Table Mountain sandstone, and I have seen no dykes in the Cape Peninsula which do. This may prove yet to be an interesting fact for the determination of the age of these dykes. On Devil's Peak one penetrates the clayslate, and Mr. Prosser informs me that another very narrow one exists in the clayslate near Mr. Henry Solomon's house. The diabase rocks are of extraordinary extent in South Africa. In the Upper Karoo beds they are the principal geological features, and indeed determine the whole character of the landscape. Dr. Cohen found them existing from 34° to 23° south latitude, and from

24° to 32° east longitude. From descriptions in Dr. Livingstone's works and Mr. Chapman's travels, they must extend to even beyond the Zambesi. They vary slightly in character in different localities in having olivine, and sometimes diallage and gabbro.

III. *The Slate Formations.*

The most interesting rocks of Cape Town are those of the slate formations, and they have been described most thoroughly by Clarke, Abel, Darwin, &c. The best point of observation of these rocks is Sea Point; the bed of the stream a little below Platteklip; Lion's Rump; and Lion's Head.

Where granite and slate meet, the former envelopes numerous parts of it, issues apophyses into it, or forms sharply defined borders, and the slate shows petrographical peculiarities, which seem to justify the existence of a contact-zone. Dr. Cohen says:—

'If this contact-zone was metamorphosed into gneiss, as is said by Hochstetter and Bain, I am afraid a wrong idea will be formed of its origin. I indeed was disappointed in what I found. Instead of gneiss, I found isolated blocks enveloped in granite, which sometimes show a gneiss-like structure, but always pass into lumpy slate, and already show that they are slate and nothing else. In several continuous parts of the contact-zone there is not even a resemblance to gneiss, especially as no felspar, or very little of it, is to be traced.

'It is therefore more correct to relegate this supposed gneiss to the contact-zone between the clayslate and granite.'

Although the three localities agree in the more essential points, viz., that everywhere the granite is separated most distinctly from the slate, and the changes in the latter consist especially in a sort of crystallization and a developement into specky slate, there are on the other hand sufficient distinctions to justify separate treatment.

Lion's Rump.

The Lion's Rump offers the best opportunity to study the formation of the slate, and in its contact with the granite as well.

At a distance that is inconsiderable from the town are quarries on the northern slope of the Lion's Rump, close indeed to Cape Town. There is a good disclosure, and also on the ridge of the hill with its bare herbage the layers are visible. Dr. Cohen examined the rock from the quarries to the Lion's Head, a distance of two miles.

'In the quarries the slate is obtained which, when fresh, is bluish black, rather brittle, and splintering with a conchoidal fracture, of considerable hardness, and a very regular grain, having a distinctly crystalline structure.

'Looking at it as a whole the slaty structure is very distinct, and large slabs are easily got. On examining a rough piece, and into a slab, no parallel arrangement of the constituent parts is observable.

'The slate is traversed by manifold narrow veins of quartz, which form a sort of net-work in it, containing enclosures like roof slate of very fine texture.

'In the upper part of the quarry the slate is altered through decomposition, and it is of a yellowish grey, very soft clay sandy stuff, and with a much fuller slate structure than that in the fresher parts.

'Clarke evidently was mistaken in regarding these upper layers as different, referring them to the Silurian, while the deeper he considers Cambrian.

'On the way to Lion's Head from the quarry, strata of a yellowish-brown clayey sandstone, rich in small scales of mica, are to be found. The alternation of layers is about twice sandstone to three times clayslate.

'At the foot of Lion's Head the slate is enveloped by granite. These especially sometimes obtain such a well developed crystalline structure, that one is inclined to class hand specimens with gneiss or mica schist. Now and then, indeed, light layers of a fine greyish mixture of quartz, felspar, and a little mica, alternate with layers, which principally consist of black manganese, so that the transverse fracture appears to be finely striped, and through this the similarity becomes very great.

'Some of the clayslate is free from knots; others again are so full of them that the knotty parts exceed the body of the rock.

'How extremely varying the degree of metamorphosis is, may be understood, when one block was found in which distinctly clay-mica-slate and gneiss-like, and even mica schist varieties occurred with gnarled slate, all

merging one into the other, but quite distinct and sharply defined from the granite.

Sea Point.

'The granite here is much changed from what it is in other parts of the valley. It becomes rich in quartz in some places, and poor in mica: in other places there are large scales of silver-white mica, and tourmaline in varying quantities. This tourmaline is, what Clarke, Itier, Hall, and others have called hornblende.

'Further on there is a region of granite with numerous enclosures of slate. Granite is still the predominating rock, but there is a generally confused mixture of granite enveloping slate, and solitary gangs of quartzite, and lastly slate wholly.

Remarks.

It will be generally conceded that Dr. Cohen has solved the question of the existence of gneiss and its exact character as developed at Sea Point and on Lion's Hill. It is merely altered slate from the metamorphosis produced by the outburst of the granite. Some of it is very like gneiss, and some of it indeed resembles mica schist; but to call it either in the absence of any quantity of felspar is misleading. When granite, during its outburst, acts on sandstone it produces as a rule quartzite; ordinary limestone it alters into crystalline and saccharoid limestones. Clay-slate it alters into mica schist or gneiss, in which we find rudely alternating laminæ of quartz, felspar, and mica, often having a foliated arrangement. The granite itself is also altered near the zone of contact to a marked extent, as would be inferred from the fact that the granite is the erupting and assailing mass. A fine illustration of these remarks I referred to in observations on Mr. Prosser's paper read at the last meeting. At the north end of the Island of Arran, in Scotland, a tremendous boss of granite has been protruded, as in Table Mountain valley, through the clayslate. The centre of the boss is granite of a very compacted character. As the clayslate is approached it alters in character until it becomes, near the clayslate, a

Schorlly granite. The clay slate at the zone of contact loses its ordinary bedded texture and passes by degrees into gneiss, in which we find rudely alternating laminæ of quartz, felspar, and mica.*

On a smaller and less effective scale the same changes have occurred on Lion's Head and wherever in the Cape Peninsula a zone of contact between the clayslate and the granite is found. There is in the heart of the intruded boss, granite, which as it approaches the clayslate alters into granite conspicuous in tourmaline,—or Schorlly granite :—the clayslate along the line of contact being altered as described into a gneissic rock. This is undoubtedly the true history of the supposed gneiss formations of Lion's Head, and there is no necessity in arguing for the two granitic outbursts of Mr. Prosser's view. One great eruption would cause all the phenomena to be explained.

Analysis of the Clayslate.

By Lohse, No. I. (Lion's Rump).

Silica	75·49
Alumina	11·54
Red oxide	1·96
Sesqui-oxide	2·57
Lime	1·77
Magnesia	1·48
Potash	1·38
Soda	3·85
Water	·45
	100·49

By Ritterhausen, No. II. (Lion's Rump).

Silica	62·21
Alumina	17·35
Red oxide	3·06
Sesqui-oxide	3 51
Lime	1·10
Magnesia	8·03
Potash	2·15
Soda	1·44
Water	2·96
	103·81

* Ramsay's Physical Geography of Great Britain, page 45.

By Ritterhausen, No. III. (Lion's Head).

Silica	68·30
Alumina	14·78
Oxide of iron	1·84
Sesqui-oxide	4·17
Lime	·99
Magnesia	2·67
Alkalies	4—5·23
Water	2·01
	98·76—99·76

By Matthews, No. IV. (Sea Point).

Silica	49·48
Alumina	25·71
Oxide of iron	4·90
Sesqui-oxide	6·86
Lime	1.32
Magnesia...	4·84
Potash	·57
Soda	5·19
Water	2·82
	101·69

By Dengler, No. V. (Sea Point).

Silica	61·03
Alumina	19·44
Oxide of iron	10·06
Lime	1·09
Magnesia	6·52
Potash	2·54
Soda	1·93
	102·61

By Waldstein, No. VI. (Platteklip).

Silica	66·01
Alumina	15·58
Sesqui-oxide	7·70
Lime	1·31
Magnesia	2·98
Potash	3·33
Soda	1·08
Water	1·62
	99·61

Sandstone Formation.

The slate is covered by horizontal banks of sandstone which are commonly called Table Mountain sandstone.

The lower strata are formed mostly of reddish brown, sandy, clayslate, changing into sandstone with profuse mica scales. According to microscopic examination these consist of quartz and mica. The mica is scarcely transparent. Small traces of felspar also occur, the products of infiltration.

They are best seen at the waterfall, near Rondebosch, on the eastern slope of the Devil's Peak.

The principal banks of the Table Mountain sandstone occur above the northern slope, and form there a perpendicular wall of 500 feet. They consist of fine grained quartzose sandstone of various colours, white, yellowish, greenish, reddish, violet, and yellowish brown. It has been often stated that the lower banks are reddish and the upper whitish. This is on account of being covered by lichens which have a de-oxidizing effect. The layers of the sandstone sometimes become con glomerate-like, through the presence of quartz crystals, mostly snowy white, but seldom larger than a hazel nut.

On Lion's Head there are very curious pipe-like cavities in the sandstone, and even cave-like hollows in which stalactites sometimes appear.

The younger formations may well form the subject of another paper.

VII. *Continuous Girders, Arched Ribs, and Tension Circles.*—By F. Guthrie.

[Read 31st July, 1878.]

In the following paper the terms *strain* and *stress* are used in the sense adopted by Rankine. A *strain* is a distortion of the form of an imperfectly rigid body; a *stress* is a force tending to produce a strain.

The subject of continuous girders has assumed some importance since the introduction of railways, for, though many engineers prefer, for certain reasons, to avoid their use when it can conveniently be done, still there are circumstances when the employment of such girders is desirable. There is some idea that the calculations of the strains and stresses of continuous girders presents peculiar difficulty. Such, however, is not the case. Supposing that the strains and stresses for each separate span can be calculated, the effect of continuity in altering these strains and stresses can be found with the utmost ease, and only involves elementary arithmetic. On a subject like this, which has already attracted the attention of able engineers and mathematicians, there is, of course, not much room for new and useful investigation, and the following observations are advanced with diffidence, as, with the multiplication of periodical and other works on engineering, it is almost impossible to say what is new and what is not.

A continuous girder is one which is supported on piers at intervals between the abutments, and is thus divided into two or more spans, and the principle of the method by which the strains and stresses of such a girder are calculated is as follows:—The girder is conceived as being rendered discontinuous at each pier. (Fig. 1.) The strains and stresses on each span being calculated; equal and opposite bending moments are then applied to

the conterminous ends until they are bent into continuity of position (Fig. 2.) Certain numerical equations are thus obtained for determining the required bending moments or stresses over the piers which are called into play owing to the continuity of the girder, and the effect of these moments is added to the strains and stresses of the various spans already calculated.

The general effect of these moments is easily seen. Thus the couple N_2 at A_2 (Fig. 2) acting on the first span diminishes the pressure on the abutment A_1, and increases the pressure on the pier A_2. The couple N_2 at A_2 acting on the second span decreases the pressure on A_2 and increases that on A_2, while N_3 at A_3 on the same span diminishes the pressure on A_2 and increases that on A_3, while N_3 at A_3 on the third span diminishes the pressure on the abutment A_4, and increases the pressure on A_3, so that the general effect of continuity is to diminish the pressure on the abutments and throw it on the intermediate piers. The effect of each couple in diminishing or increasing the pressures on the abutments and piers is obviously found by dividing the moment of the couple by the length of the span on which it is acting.

The case of a continuous uniform girder with equal spans seldom actually occurs in practice, but its consideration is useful as a preliminary to the investigation of more practical cases. The following example of a particular case will illustrate the extreme simplicity of the calculations involved.

Let n_1, n_2, in (Fig. 3) stand for the moments at the point A_1, A_2 divided by half the product of the length and weight of each span. Let p stand for the pressure on each support due to continuity, divided by half the weight of a span, and let α stand for the angle of deflection of direction of the girder on the next span at each point of support, divided by $\frac{cwl^2}{12}$ when the number of spans is even and by $\frac{cwl^2}{24}$ when odd; c being the modulus of curvature for the girder,—*i.e.*, the curvature at any point produced by a unit moment on a unit of length.

The following table gives these several quantities at each point of support:—

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9
	$\frac{1}{2}$	$\frac{0}{1}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{3}{14}$	$\frac{4}{19}$	$\frac{11}{52}$	$\frac{15}{71}$	$\frac{41}{194}$
n	$\frac{0}{194}$	$\frac{41}{194}$	$\frac{30}{194}$	$\frac{33}{194}$	$\frac{32}{194}$	$\frac{33}{194}$	$\frac{30}{194}$	$\frac{41}{194}$	$\frac{0}{194}$
p	$-\frac{41}{194}$	$\frac{52}{194}$	$-\frac{14}{194}$	$\frac{4}{194}$	$\frac{-2}{194}$	$\frac{4}{194}$	$\frac{-14}{194}$	$\frac{52}{194}$	$\frac{-41}{194}$
a	$\frac{56}{194}$	$\frac{-15}{194}$	$\frac{4}{194}$	$\frac{-1}{194}$	$\frac{0}{194}$	$\frac{-1}{194}$	$\frac{4}{194}$	$\frac{-15}{194}$	$\frac{56}{194}$

The fractions in the first line are the convergents to the continued fraction

$$\cfrac{1}{4+\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1}}}} \text{ \&c.}$$

the law of their formation from each other is obvious.

The numerators in line two are obtained by alternately adding and subtracting the alternate numerators in line 1, beginning from the end.

The numerators, except the first, in line three are the alternate denominators of the fractions in line 1 with alternate signs. The first is the last *numerator* in that line.

The numerators in line 4 are the sums of the consecutive pairs of numerators in line 1 with alternate signs.

As the strains and stresses of any detached span of such a girder are easily calculated, the whole condition of the girder is known.

The distances of the points of contrary flexure in each span from the end of that span, are the roots of the quadratic

$$a^2 - (1 + n_r - n_{r+1})\, a + n_r.$$

Another preliminary matter, the consideration of which essentially simplifies the calculations in practical cases, is the effect on a continuous girder of a bending stress at one end.

The effect of such a stress will be to produce strains which continually decrease in amount towards the other end (See Fig. 4.) The critical strains at each point of support are easily calculated from the fact that they must be such as to bend the end of each span into continuity of position with the end of the next span. This gives a series of equations connecting these moments with each other of the form

$$N_3 = 2\frac{l_1 + l_2}{l_2} N_2$$

$$N_4 = 2\frac{l_2 + l_3}{l_3} N_3 - \frac{l_2}{l_3} N_2$$

where l_1, l_2 are the breadths of the several spans. These equations enable us to express each moment in terms of the terminal moment N_6, and the moments at the end of each span being known, the strains and stresses in that span can be set down at once.

When the spans are of equal length the calculations become expressly simple. Subjoined is an example for a five span girder:

	A_1	A_2	A_3	A_4	A_5	A_6
$\frac{a}{l}$	$\frac{0}{1}$	$\frac{1}{3}$	$\frac{4}{11}$	$\frac{15}{41}$	$\frac{56}{153}$	$\frac{209}{571}$
$\frac{N}{N_6}$	$\frac{0}{209}$	$\frac{19}{209}$	$\frac{76}{209}$	$\frac{285}{209}$	$\frac{532}{209}$	$\frac{209}{209}$
$\frac{6a}{clN_6}$	$\frac{19}{209}$	$\frac{38}{209}$	$\frac{57}{209}$	$\frac{76}{209}$	$\frac{95}{209}$	$\frac{114}{209}$
$\frac{Pl}{N_6}$	$\frac{19}{209}$	$-\frac{76}{209}$	$\frac{304}{209}$	$-\frac{190}{209}$	$\frac{114}{209}$	$\frac{76}{209}$

The first line gives the position of the point of contrary flexure relatively to the end of each span, its law of formation is obvious.

The second line gives the ratio of the bending moment at each point of support to the terminal moment

The fractions in the third line multiplied by $\frac{clN_6}{6}$ give the deflections in directions at these points, and then if the fourth line multiplied by $\frac{N_6}{l}$ give the pressures at these points.

When equal and opposite moments act at the two ends of such a girder, the question is even more simplified, as will be seen from the following instance of a five span girder. (Fig. 5).

	A_1	A_2	A_3	A_4	A_5	A_6
	$\frac{0}{1}$	$\frac{1}{1}$	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{4}{7}$	$\frac{11}{19}$
$\frac{a}{l}$	$\frac{10}{24}$	$\frac{5}{8}$	..	$\frac{1}{8}$	$\frac{5}{24}$	..
$\frac{N}{N_6}$	$\frac{10}{19}$	$-\frac{5}{19}$	$+\frac{1}{19}$	$+\frac{1}{19}$	$-\frac{5}{19}$	$+\frac{10}{19}$
$\frac{2a}{clN_6}$	$\frac{11}{19}$	$-\frac{3}{19}$	$+\frac{1}{19}$	$-\frac{1}{19}$	$+\frac{3}{19}$	$-\frac{11}{19}$
$\frac{Pl}{6N_6}$	$\frac{4}{19}$	$-\frac{5}{19}$	$+\frac{1}{19}$	$+\frac{1}{19}$	$-\frac{5}{19}$	$+\frac{4}{19}$

The first line contains the convergents to

$$1+\cfrac{1}{1+\cfrac{1}{2+\cfrac{1}{1}}}$$ &c.

Their method of formation is obvious. The other three lines, giving the points of contrary flexure, the relative bending stresses, the angular deflections and the pressures due to bending moments, are simply read off. The terminal pressure is however to be found by the rule that its numerator is half the sum of the numerator and denominator of the last fraction but two of the first line.

With these preliminaries the consideration of any case likely to occur in practice is much simplified. The most ordinary form of continuous girder is one with shorter terminal spans, but equal intermediate spans, and the method of treating such a case is best illustrated by an example.

Let $A_1\ A_6$ (Fig. 6) be a girder of five spans, of which the end spans are $\frac{1}{2}$ the length of the intermediate spans.

Disconnecting the girder at A_2 and A_5, we get:—

$\angle^r$ deflection at A_2 of termal span, $\frac{cw_1l_1^2}{24} = \frac{cwl^2}{192}$

$\angle$ „ „ central span r, $\frac{1}{5}\frac{cwl^2}{24} = \frac{cwl^2}{4}$

$\angle^r$ deflection of terminal span due to N, $\frac{cl_1N}{3} = \frac{clN}{6}$

$\angle$ „ „ central span „ , $\frac{1}{5}\frac{clN}{2} = \frac{6}{10}\,clN$

whence $\left(\frac{3}{10} + \frac{1}{6}\right) N = \left(\frac{1}{40} + \frac{1}{192}\right) wl$

$$\frac{14}{30} N = \frac{29}{960} wl$$

$$N = \frac{29}{448} wl$$

$$= \frac{29}{224} \frac{wl}{2}$$

Whence for the moments at the various points of support we have:—

A_2	A_3	A_4	A_5
$\frac{29}{224}$	$-\frac{1}{5}\frac{29}{224}$	$-\frac{1}{5}\frac{29}{224}$	$\frac{29}{224}$
	$+\frac{1}{5}$	$+\frac{1}{5}$	
or, $\frac{29}{224}\frac{wl}{2}$	$\frac{39}{224}\frac{wl}{2}$	$\frac{39}{224}\frac{wl}{2}$	$\frac{29}{242}\frac{wl}{2}$

From which the pressures and other strains and stresses can be determined.

Where the spans are of irregular length, the calculation is still within the limits of the most elementary arithmetic. Subjoined is an example (Fig. 7).

	A_2	A_3	A_4	A_5	A_6
$p_r = \frac{m_r l_r^2 + m_{r+1} l_{r+1}^2}{4 l_{r+1}}$	9·45	14·2083	18·	17·05	11·8125
$\alpha_r = 2\frac{l_r + l_{r+1}}{2}$	3·6	3·6̇	4·	4·4	4·5
$\beta_r = \frac{l_r}{l_{r+1}}$	·81	·8̇3	1·	1·2	1·25
$\gamma_r = \alpha_r \gamma_{r-1} - \beta_r \gamma_{r-2}$	3·6	12·3̇6	45·8̇6	186·97̇3	784·04̇6
$\delta_r = p_r - \alpha_r \delta_{r-1} - \beta_r \delta_{r-2}$	9·45	-20·44̇16	90·31̇6	-355·81̇3	1500·07̇6
$N_r = \delta_{r-1} - \gamma_{r-1} N_{r-1}$	1·913	2·662	3·219	2 562	1·913

The various lines are calculated as indicated by the formulæ annexed.

Even the effect of a subsidence of one of the points of support can be determined with the greatest ease as follows:—

Calculate the strains and stresses on the girder, considering this support wholly removed, and find the changes of stress and strain throughout, and thence find the depression of the point of the girder above the support so removed, and then correct each strain and stress by adding or subtracting the same fraction of the changes of strain that the actual subsidence of the pier is of the subsidence due to the entire removal of that pier. Thus, in the above case, if the support A_4 were wholly removed (Fig. 8) the bending stresses would be as follows:—

A_2	A_3	A_5	A_6
$-\cdot17$	10·09	10·09	$-\cdot17$

whence the depression of the point A_4 is easily calculated to be

$$\frac{4\cdot91\ cw \times 12^4}{96}$$

where c depends on the elasticity of the girder. If the actual subsidence of the pier A_4 is, say, one-third of this, then the actual correction for this subsidence will be one-third of the changes due to the total removal of A_4.

Thus, for example, the pressure on the abutments in the above case would be affected as follows. The pressures in terms of w, the weight of a unit of length when A_4 is in position:—

	A_1	A_2	A_3	A_4	A_5	A_6	A_7
Due to wt. ..	2	4·5	5·5	6·	5·5	4·5	2
Due to flexion ..	—·48	·35	·02	·22	·02	·35	— 48
Total ..	1·52	4·85	5·52	6·22	5·52	4·85	1·52

When A_4 is wholly removed:—

A_1	A_2	A_3	A_4	A_5	A_6	A_7
2·	4·5	8·5	..	8·5	4·5	2·
·04	— 1·75	1·71	..	1·71	— 1·75	·04
2·04	2·75	10·21	..	10·21	2·75	2·04
1·52	4·85	5·52	6·22	5·52	4·85	1·52
·52	— 2·10	4·69	— 6·22	4·69	— 2·10	·52

If then the pier A_4 sank by half the amount required to take the entire weight off it, we should have (Fig. 9).

A_1	A_2	A_3	A_4	A_5	A_6	A_7
1·52	4·85	5·52	6·22	5·52	4·85	1·52
·26	— 1·05	2·35	— 3·11	2·35	— 1·05	·26
1·78	3·80	7·87	3·11	7·87	3·80	1·78

all in terms of w, where w is the weight of a unit of length of the girder and is equal to $\frac{W}{30}$ where W is the weight of the entire girder.

The methods above indicated are applicable to determine the effect of a living load whether distributed or local.

Divide off the loaded span or spans, and calculate the several parts of the girder separately. Then apply to the continuous ends moments N_1 and N_2, such as shall render the sections continuous in position and direction. Two simple arithmetical equations result for determining these moments, and the effect of these moments on each section of the girder are then calculated with the utmost ease by the method above indicated.

The subject of arched girders has perhaps hitherto been less satisfactorily investigated than that of continuous girders.

It may be approached as follows in any curve:—

$$\frac{1}{\rho} = \frac{1 - \left|\frac{dr}{ds}\right|^2 - r\frac{d^2r}{ds^2}}{\sqrt{1 - \left|\frac{dr}{ds}\right|^2}}$$

where ρ is the radius of curvature.

Where the deviation from the circular form is very small $\left|\frac{dr}{ds}\right|^2$ may be omitted, and we get

$$\frac{1}{\rho} = \frac{1}{r} - \frac{d^2r}{ds^2}$$

If, now, a be the radius of a circle, and Δr its variation due to a slight deflection

$$\frac{1}{\rho} = \frac{1}{a} + \frac{\Delta r}{a^2} + \frac{d^2\Delta r}{ds^2}$$

Where the *superadded* curvature due to a slight deflection is approximately

$$\frac{d^2\Delta r}{ds^2} + \frac{\Delta r}{a^2}$$

and

$$\frac{d^2\Delta r}{ds^2} + \frac{\Delta r}{a^2} = cm$$

where m is the moment of deflection, being generally a function of s, and c is a constant depending on the elasticity of the material of the girder and on its transverse section.

From this equation Δr can generally be easily determined in terms of s, and from Δr the overlap Δs is determined by the obvious relations

$$\Delta s = \frac{1}{a} \int \Delta r ds. \quad \text{(Fig. 10.)}$$

From Δr and Δs, the vertical and horizontal displacements of the end of the girder due to deflection are easily calculated.

Subjoined is a summary of some of the principal results for various forces :—

I.—Weight vertical (Fig. 11).

$$M = wa (\sin \phi - \sin \theta)$$

$$\Delta r = \frac{cwa^3}{2} (\sin 2\phi - \phi \cos \phi - \sin \phi)$$

$$\Delta s = \frac{cwa^3}{2} (3\phi \sin \phi + \cos \phi - \sin^2 \phi - 1)$$

$$\alpha = \frac{cwa^3}{2} (\phi \sin \phi - 2 \sin^2 \phi)$$

when α is the deflection of the end of the girder in direction.

$$\Delta x = \frac{cwa^3}{2} \left(\phi (2 - \cos 2\phi) + \frac{3}{2} \sin 2\phi - 2 \sin \phi \right)$$

$$\Delta y = \frac{cwa^3}{2} \left(\phi \sin 2\phi - (1 + 3 \cos \phi)(1 - \cos \phi) \right)$$

$\frac{l}{a}$	$\frac{\Delta r}{cwa^3}$	$\frac{\Delta s}{cwa^3}$	$\frac{\alpha}{cwa^2}$
$\frac{\pi}{2}$	$-\frac{1}{2}$	$\frac{3\pi}{4} - 2$	$\frac{\pi}{4} - 1$
π	$\frac{\pi}{2}$	-2	0
2π	$-\pi$	0	0
$n\pi$	$\pm \frac{n\pi}{2}$	$\frac{-2}{0}$	0 $\begin{matrix} n \text{ odd} \\ n \text{ even} \end{matrix}$

II.—Weight horizontal (Fig. 12):

$$M = wa(\cos\theta - \cos\phi)$$

$$\Delta r = \frac{cwa^3}{2}(\cos\phi - \phi\sin\phi - \cos^2\phi)$$

$$\Delta s = \frac{cwa^3}{2}(\sin 2\phi + \sin\phi - 3\phi\cos\phi)$$

$$a = \frac{cwa^3}{2}(\sin 2\phi - \sin\phi - \phi\cos\phi)$$

$$\Delta x = \frac{cwa^3}{2}(1 - \cos\phi)(1 + 3\cos\phi - \phi\sin 2\phi$$

$$\Delta y = \frac{cwa^3}{2}\left(\left(\tfrac{3}{2}\sin 2\phi - \phi\,(2 + \cos 2\phi)\right)\right.$$

$\frac{l}{a}$	$\frac{\Delta r}{cwa^3}$	$\frac{\Delta s}{cwa^3}$	$\frac{a}{cwa^3}$
$\frac{\pi}{2}$	$-\frac{\pi}{4}$	$\frac{1}{2}$	$-\frac{1}{2}$
π	-2	$\frac{3\pi}{2}$	$\frac{\pi}{2}$
2π	0	-3π	$-\pi$
$n\pi$	$-\frac{2}{0}$	$\pm\frac{3n\pi}{3}$	$\pm\frac{n\pi}{2}$ n odd n even

III.—A simple bending stress at the end (Fig. 13):

$$M = cN$$

$$\Delta r = ca^2N(\cos\phi - 1)$$

$$\Delta s = ca^2N(\phi - \sin\phi)$$

$$a = -caN(\sin\phi)$$
$$\Delta x = ca^2N(\phi\sin\phi + \cos\phi - 1)$$
$$\Delta y = ca^2N(\phi\cos\phi - \sin\phi)$$

l	$\frac{\Delta r}{cNa^2}$	$\frac{\Delta s}{cNa^2}$	$\frac{a}{cna}$
$\frac{\pi}{2}$	-1	π	-1
π	-2	$\frac{\pi}{2}-1$	0
2π	0	π	0
$n\pi$	$-\frac{2}{0}$	$n\pi$	0 $\begin{matrix}n\text{ odd}\\ n\text{ even}\end{matrix}$

IV.—Circular arc deflected by its own weight (Fig. 14.)

$$M = wa\frac{a}{l}(\theta\sin\theta + \cos\theta - \phi\sin\theta - \cos\phi)$$
$$\Delta r = cwa^3\left\{\left(\frac{1}{\phi} - \frac{\phi}{4} - \frac{\cos\phi}{\phi}\right)\cos\phi - \frac{\sin\phi}{4}\right\}$$
$$\Delta s = cwa^3\left\{\left(\frac{\phi}{4} + \frac{5}{4\phi} + \frac{\cos\phi}{\phi}\right)\sin\phi - \frac{5}{4}\cos\phi - 1\right\}$$
$$a = cwa^2\left\{\left(\frac{\phi}{4} + \frac{3}{4\phi} + \frac{\cos\phi}{\phi}\right)\sin\phi - \frac{\cos\phi}{4}\right\}$$
$$\Delta x = cwa^3\left\{\frac{\phi}{4} + \frac{1}{4\phi}(1-\cos\phi)(5+9\cos\phi) - \tfrac{1}{8}\sin 2\phi - \sin\phi\right\}$$
$$\Delta y = cwa^3\left\{\frac{9}{8\phi}\sin 2\phi - (\cos\phi + \tfrac{1}{8})^2\right\}$$

$\frac{l}{a}$	$\frac{\Delta r}{cwa^3}$	$\frac{\Delta s}{cwa^3}$	$\frac{a}{cwa^3}$
$\frac{\pi}{2}$	$-\frac{1}{4}$	$\frac{\pi}{8}+\frac{5}{2\pi}-1$	$\frac{\pi}{8}-\frac{3}{2\pi}$
π	$\frac{\pi}{4}-\frac{2}{\pi}$	$\frac{1}{4}$	$-\frac{1}{4}$
2π	$-\frac{\pi}{2}$	$-\frac{9}{4}$	$\frac{1}{4}$
$n\pi$	$-\left(\frac{1}{n\pi}\pm\left(\frac{n\pi}{4}-\frac{1}{n\pi}\right)\right)$	$-1\mp\frac{5}{4}$	$\pm\frac{1}{4}$ n odd, n even

From these data the thrust of a circular arc which is not allowed to expand, caused by a weight $2w$ at the crown, is

$$w_1 = w\,\frac{2(1-\cos\phi)(1+3\cos\phi)-2\phi\sin 2\phi}{2\phi(2+\cos 2\phi)-3\sin 2\phi}$$

where ϕ is half the angular expanse of the arc (Fig. 15) and the thrust due to evenly distributed weight is

$$w_1 = w\,\frac{\sin 2\phi\left(\frac{9}{29}-2\phi\right)-4-5\cos 2\phi}{2\phi(2+\cos 2\phi)-3\sin 2\phi}$$

$$= w\,\frac{\sin\psi\left(\frac{9}{\psi}-\psi\right)-5\cos\psi-4}{\psi(2+\cos\psi)-3\sin\psi}$$

when w is half the entire weight, and $\psi = 2\phi$.

When ϕ is a small angle this gives

$$r_1 = \frac{25w}{16\phi} \text{ for load.}$$

$$r_1 = \frac{w}{\phi} \text{ for distributed weight}$$

When $\phi = \frac{\pi}{2}$

$w_1 = \frac{2w}{\pi}$ for load at crown

$w_1 = \frac{w}{\pi}$ for distributed weight.

By combining together the deflection caused by weight, that caused by the vertical pressures from the abutments and that caused by horizontal thrust, when the arc is not allowed to spread, we get for the *depression* of the crown of a semicircular arc

$$cwa^3\left(\frac{5\pi}{8} - \frac{3}{\pi} - 1\right) = \cdot 0085657\ cwa^3$$

shewing that the crown of a semicircular arc of uniform weight is depressed, not elevated, as is sometimes stated.

The deflection of the crown of a circular arc of small angular magnitude will be:

(1) an elevation due to weight of $\frac{cwl^3}{8}$

a depression due to abutments of $\frac{cwl^3}{3}$

an elevation due to thrust of $\frac{5cwl^3}{24}$

and since the sum of these deflections is zero, it follows that the crown of a circular arc of small rise due to bending stresses is nothing.

This suggests that the depression due to compression should be calculated, and the result is as follows:

$$\Delta = \frac{a}{an}\frac{\left(w_1 + \frac{w}{\phi}\right)\sin\phi - w\cos\phi}{\cot\frac{\phi}{2} + \frac{\phi}{2}\left(1 - \cot\frac{2\phi}{2}\right)}$$

where ϕ is small this comes to

$$\Delta = \frac{cwl\phi}{a\phi^2}$$

where l is the length of the arc, a the area of a section, ϕ the moment of inertia of a section about a neutral axis and w the entire weight.

In the case of a semicircular arc

$$\Delta = \frac{3caw\phi}{a\pi}$$

from which it can be calculated that in this case the depression of the crown due to bending stresses is to its depression due to compression as a^2 to $(\overline{5\cdot2})b]^2$ nearly. When b is the depth of the girder, supposed to consist of two equal flanges with a tension web.

An interesting development of the circular arc is the elastic ring.

An elastic ring, acted on by two equal and opposite radial forces, will obviously be compressed in the direction of the diameter along which those forces act, and expanded in the opposite direction. (Fig. 16.)

Calling the force $2w$, and the bending stress at A and A_1 due to compression N,

$$w \text{ at } A \text{ gives } \Delta r = -\frac{\pi}{2} cwa^3,\ \Delta s = 2cwa^3$$

$$N \text{ ,, } A \quad \text{,,} \quad \Delta r = 2ca^2N,\ \Delta s = -\pi ca^2M$$

And since A does not move laterally,

$$\pi ca^2N = 2cwa^3$$

$$N = \frac{2wa}{\pi}.$$

Whence A is elevated by

$$\frac{\pi}{2} cwa^3 - 2ca^2N = 2cwa^3\left(\frac{\pi}{4} - \frac{2}{\pi}\right)$$

Whence each of the points A and A_1 are moved towards the centre by

$$cwa^3\left(\frac{\pi}{4} - \frac{2}{\pi}\right).$$

The deflection at any point will be

$$\Delta r = cwa^3\left(\frac{\phi}{2}\cos\phi - \frac{\sin\phi}{2}\right) - ca^2N\ (\cos\phi - 1),$$

$$= cwa^3\left(\frac{\phi}{2}\cos\phi - \frac{\sin\phi}{2} + \frac{2}{\pi}(1 - \cos\phi)\right),$$

Or, removing the origin to the centre of symmetry,

$$\Delta r = cwa^3\left(\frac{\phi}{2}\sin\frac{\phi}{2} - \frac{\sin\phi}{2} - \frac{\pi}{4}\cos\phi + \frac{2}{\pi}\right),$$

$$= cwa^3\left(\left(\frac{\phi}{2} - \frac{\pi}{4}\right)\cos\phi - \frac{\sin\phi}{2} + \frac{2}{\pi}\right).$$

This valve of Δr is nothing when $\phi = 43°\text{,,}53'\text{,,}29''$ very nearly, which gives the point of the circumference whose position remains undisturbed.

The points of maximum and minimum curvature are found from $\sin\phi\left(\phi - \frac{\pi}{2}\right) = 0$, and the neutral points from

$$wa \sin\phi = N$$
$$\sin\phi = \frac{2}{\pi}$$
$$\phi = 39° 32' 24''{\cdot}9$$

When $\phi = \frac{\pi}{2}$

$$\Delta r = \left(\frac{2}{\pi} - \frac{1}{2}\right) cwa^3 = cwa^3 \times .136{,}198.$$

These results enable us to treat generally the deflections of a tension wheel, that is, of a wheel the rigidity of whose tire is secured by radial ties instead of by rigid spokes or struts.

It is obvious that all that is required is to calculate the deflection from the centre of each critical point due to the different pairs of forces, and then by equating to nothing the deflections of those points which are rigidly connected, equations are found for determining the strains on the various ties.

Subjoined are the results of various particular cases.

In figure 17 the ring is compressed by equal and opposite forces w at A and A_1, and prevented from expanding by the tie $B\,B_1$. The tension in the tie is ·918 w. Figures 18, 19, 20, and 21 are cases where the number of ties is greater.

The following points call for special attention. 1. That *all* the ties are in tension even those nearest to the points of application of the compressing forces. 2. That the tensions are alternately greater and less with a constant approach to equality ; that is to say, the least tension is found in the tie nearest to the points of application of the compressing forces, the greatest in the next tie, the next least in the next tie, and so on.

If the applied force be at the nave of the wheel instead of at the circumference the calculation is somewhat more complicated. The following plan, however, may then be adopted.

Imagine a complete ring acted on by various forces towards the centre.

Where each force acts the circumference will be flattened. Now let the ring be cut close by one force, and one end be held in position, it is then obvious that the overlap will be as in Fig. 22.

Now apply to the extremity three forces, one tangental, the other radial, and the third a bending stress, so that the two ends may be brought into continuity of position. Three equations result for determining these forces. Then calculate the deflections caused by each circumferential force, and by the terminal forces representing the thrust, shear and bending stress at the point of imaginary section. Equate to nothing the sum of the deflections of each point whose distance from the centre remains constant, and we get a number of equations by which the different forces can be determined.

The equation for determining the deflection of any point A_2, is as follows:

$$\Delta r = \frac{cwa^3}{\pi}\left(\pi\Sigma_{o,r}w\sin(\phi_r-\phi)-\Sigma_{o,r}w(\phi_r-\phi)\cos(\phi_r-\phi)\right.$$
$$-(\Sigma_{o,n}w\phi\cos\phi)\left(\frac{\phi_r}{2}\cos\phi_r-\frac{\sin\phi_r}{2}\right)-(\Sigma_{o,n}w\phi\sin\phi)$$
$$\left.\left(\frac{\phi_r}{2}\sin\phi_r\right)-(\Sigma w)(1-\cos\phi)\right)$$

The stresses in the example shewn in Fig. 23 are calculated from this formula.

The weight w is applied to the nave of a tension wheel with 8 radial tires and the strains are then

$$w_0 = \cdot 89\, w$$
$$w_1 = \cdot 86\, w$$
$$w_2 = \cdot 92\, w$$
$$w_3 = \cdot 78\, w$$

It will be observed that, as before, the stresses are alternately greater and less, but tend to equality, the least is that next to w, the greatest next to that, the next to the least comes next, and the next to the greatest follows, and so on, thus reproducing the law of stresses in the continuous girder.

The case of an elastic ring deflected by its own weight is perhaps more interesting theoretically than practically useful. Two cases may be considered, one in which the ring is suspended from its circumference, the other in which it rests on a horizontal support. Neither case presents any practical difficulty.

In the first case (Fig. 24) consider the ring as discontinuous at the base, and calculate the strains at the extremity by the foregoing formula. Then apply horizontal forces and moments so as to bring the extremities into continuity of position. The horizontal force so required is $\frac{w}{4\pi}$ when w is the entire weight of the ring, and $N = \frac{w}{4\pi}$ and the consequent radial deflection at any point P is:

$$\Delta r = \frac{cwa^3}{\pi}\left(\left(\frac{\phi^2}{4} - \frac{\phi\pi}{2} + 1\right)\cos\phi - \left(\frac{\phi}{2} - \frac{2}{\pi}\right)\sin\phi - 1\right)$$

The neutral point is given by the equation $\tan\phi = 2(\pi - \phi)$.

The case of an elastic ring supported on a horizontal plane is treated in a similar manner, and gives parallel results.

VIII. *Some Observations on Witchcraft in Basutoland:*— By Charles Griffith, Governor's Agent.

[Read 25th September, 1878, by J. X. Merriman, Esq.]

The whole system and institution of witchcraft plays such an important part in the scheme of savage society, and its influence over the minds and action of the natives of Africa is so debasing, that a study of all its variations and peculiarities ought to be of much interest to the ethnologist, the missionary, and the statesman. The witch doctor may be said to be the great foe of civilization and good Government, and unfortunately he is almost universal throughout Africa. Appearing as the blood-stained fetish worshipper in the equatorial regions, whence he was imported into Jamaica and our West India possessions in the shape of the Obeah man, countless victims almost daily mark the force of terror which stands in those dark regions in the place of all the elaborate systems of art, science, government, and religion which in other climates the imagination of more favoured races has developed. The intellect of Caliban, in these dark rites, which would be awful if they were not grotesque, finds means to satisfy the craving for the supernatural, and gives expression to the first glimmerings of those feelings to the outcome of which we owe a great part of that complex civilization which surrounds us. Towards the eastern and south-eastern parts of the continent, the terrorism of witchcraft has developed into an important engine of statecraft, but in its social aspect it is decidedly milder than in the equatorial belt, while among the Hottentots, and as far as we are able to learn among the scattered fragments of the Bushman race, witchcraft is mixed up with observances and beliefs, such, for instance, as those connected with animal worship and with respect paid to the heavenly bodies which seems to point to a different origin for the supernaturalism of these races, and perhaps indicates the decaying

remains of an earlier and higher state of society scarcely to be traced in any other particular among these beings who are generally regarded as belonging to the typical lowest depth of humanity.

The form of witchcraft with which we are most intimately acquainted in South Africa, is connected with that branch of Animism, to use Mr. Tylor's word, which is founded on a belief in and a respect paid to, the *manes* of deceased ancestors. This appears to be the governing idea, and is, I need scarcely point out, similar to that to which among other races we owe so many beautiful myths which have for thousands of years delighted alike the school-boy and the man of letters.

This culture of the *manes* is, however, more or less completely obscured, and the various ramifications which it has assumed among the daily life of the different tribes has caused the underlying idea to be in many cases entirely lost sight of. The principal branches of the supernatural profession among the Bantu tribes are rain-making, the cure of diseases, and the providing of charms or medicine to ensure the recipient success in his undertaking, while again the cure of diseases has developed into what is now the most important branch of this superstition, the indication by the wizard of the person or things who have caused either sickness or other misfortune, a gift of discovery which has been diverted into a horrible engine of wrong-doing and oppression. The details of witchcraft differ, as might be expected, among the several tribes who have severed from the parent stock, though in all it is presumed that they start from the original manes worship above alluded to. Most interesting particulars regarding our frontier Kafirs have been published by the Revs. Dugmore and Holden, and a wide field still remains to which I venture to call the attention of the ethnological section of this society, for research as to the origin and development of many of the facts collected by these gentlemen and others which, if more fully studied, might tend to throw much light on some of the problems which are engaging the attention of our more advanced thinkers. The following notes were kindly supplied by Mr. Griffith, the Governor's Agent in Basutoland, and they will, I believe, indicate the existence among that people of a milder form of superstition such, as we might have looked for among the

less savage Bechuana race, as well as in some respects a greater play of fancy which theorists may perhaps trace to the different character of the locality which forms the country of the tribe.

Notes on Witchcraft, Basutoland.

The Basutos make a marked distinction between witchcraft (boloi in Sisuto), and doctoring (bongaka), at the same time many *Dingaka* (doctors) are also *baloi* (witches), yet most *baloi* are not doctors.

A man becomes a doctor (ngaka) by education; he generally learns to know medicines and their uses from his father, who communicates all his medical knowledge to him as a legacy, but before the *ngaka* can practise, his father or master must *phatsa* (innoculate) him, or the medicines will not take effect,—this prevents outsiders from practising without a licence. If the young *ngaka* is enterprising he finds out other medicines from other *dingaka*, the fee usually paid being an ox for each medicine pointed out to him. The *ngaka* does not profess to cure all diseases, only a certain number; if he undertakes a case he is supposed to know the disease and to profess that he is able to cure it; he is only paid if a cure takes place, but any sheep or cattle slaughtered during the treatment for the purpose of purification do not count as payment, although all the flesh may be given to the doctor; they can only count as compensation for his medicines and for the trouble he has had in digging for them and cooking them.

As most diseases are supposed to be caused by a spell cast over the patient it is necessary for the doctor (ngaka) to know something about charms, so as to break the spell; a notable step toward breaking the spell is the discovery of the witch, which is made by the "bones" (ditaola), the doctor is therefore required to be a "*Senoke*" (diviner) though all doctors are not. By throwing the divining bones or *ditaola* he finds out who is the witch, and what must be exacted from the witch, either in the shape of payment or punishment or by the performance of some act in order that the spell may be removed; of course if the patient is a chief or influential person the witch indicated by the divining bones has a bad time of it.

The same doctor was good enough to throw the bones (dolosi) at my request to indicate the whereabouts of some missing oxen. Possibly, however, the fee which was contingent on the success of his predictions was not tempting enough, for the oxen were never recovered, though in many cases I was informed that a magic consultation with the doctor, who generally has a shrewd idea of how the world wags, leads to a recovery of stolen property. I have also heard of white people who go further and employ them as Europeans do gipsies in an avowedly supernatural capacity. Truly between the ragged dirty witch doctor throwing his bones and the inspired priestess of the Pythian Apollo, giving her oracles to embassies sent by states who represented the civilization and culture of the world, there is a sufficiently wide interval, and yet perhaps not so wide as at first sight might appear. The degrading and incomprehensible phenomenon of spiritualism flourishing side by side with the most advanced theories of science seems to shew that our African witchcraft is only a branch of a world-wide error, if it does not indeed indicate the melancholy truth that fetishism of some kind or another is a craving of humanity; and that refine and civilize as we will, the terrorism of the supernatural is one of those dark facts of our nature akin to our passions themselves, the inheritance perhaps of some brute ancestor, which neither civilization, education, nor even a higher faith itself, is wholly able to subdue.

IX. *The Granites and Gneiss of the Colony.*—By W. Prosser, F.G.S.

[Read 27th February, 1878.]

There are certain features in connection with the granites and gneiss of Sea Point that are of sufficient importance to entitle their being brought before the notice of this Society. For the sake of clearness, I shall briefly enumerate the chief points to which I am desirous of directing your attention this evening.

Firstly.—There are evidences that the granite of Sea Point, after protruding itself through the Silurians had overlaid these sedimentary beds, in lateral directions, for some distance.

Secondly.—That this overlying granite was one of the agents concerned in bringing about the present metamorphic character of these rocks, when it occurred at any considerable distance from the line of the central granitic dike.

Thirdly.—That the presence of gneiss over the clayslate and immediately beneath the granite, tends to prove that more than one granitic eruption must have taken place.

Lastly.—The utilization of the presence of the position of the granite over the clayslate for obtaining water by boring.

The Table Mountain range is one of the best places to commence studying the rocks of the Colony. Here we have a certain order of succession.

(1) Granite.
(2) Silurian.
(3) Devonian.

The same order is always observable elsewhere. The Silurian, in all its mountain chains, is accompanied by the protruding granite, and is generally capped by the Table Mountain sandstone. Hence it follows that any general laws which can be deduced respecting the relative

positions of these three great rock divisions as seen in our own neighbourhood, holds good for the rest of the colony. For instance, the granite of Bain's Kloof is superimposed by the Silurians which in turn are again covered by Devonian sandstones. Again, near Worcester, we have the Silurian, with the granite, and above them are seen the sandstone. Nay, more, the very tabular form of this district is exceedingly common in the southern and western parts of the colony.

Considerable analogy seems to prevail between the granites of the Cape and those of Namaqualand as described by Mr. Wyley. There, as here, the same order is preserved with the Silurian, Gneiss, Granite, and Table Mountain Sandstone. Thus, for all practical purposes, we may regard the lithological phenomena of the Lion's Head, and its spur, Sea Point, as a type of what is seen in other parts of South Africa.

With the exception of Kamiesberg and Lilyfontein the granite of the colony nowhere gives that air of grandeur to the scenery which one sees associated with it in Europe. On the contrary, in South Africa, the granitic scenery is always subordinate to that of the Silurian and Devonian, because it is always capped by these formations. The Paardeberg and the Paarl are the most prominent granite elevations; still these are only some twelve or fifteen hundred feet in height. Possibly the present elevation of the granite peaks, is by no means what it was before the abrading and lessening influences of the Silurian and Devonian periods were brought to bear upon them. The presence of granite, however, as a basement rock of many of our mountain ranges, plays an important part in the formation of the scenery of the colony: nowhere has it contributed to form bolder or more picturesque views than in the neighbourhood of Cape Town.

At one time granite was considered to be the primary rock work in the earth's crust, that upon which the earliest sedimentary formation were invariably laid. Now, however, a different view is held, for many examples occur of newer granites. Indeed, granite may be of any age, as far as the era of its deposition is concerned; as to the time or source of its origin nothing is known. The space in time, when the granite of the Cape colony was brought to the surface, is placed beyond a doubt by the

surrounding rocks. Having protruded through, or been spread out over, the clayslates, the granites in question belong to that period in palæozoic days which is between the Silurian and the Devonian, *after* the Silurian, and *before* the old Red Sandstone days. This is at once demonstrated by its occurrence first through, and then over, the former, while it lies below the latter. There is no instance in the colony of the old Red having been in any way disturbed by the granite. This proves that the granitic erruption had ceased with the deposition of the Devonian rocks.

Mr. G. A. Bain, speaking of the Gneiss (Granites) of the Cape, says :—" Gneiss never occurs but in contiguity with granite, for it seems always to pass into clayslate when beyond the influence of the Plutonic rocks below. Gneiss occurs at Platte Klip at the foot of Table Mountain, Hottentots' Holland, and near Little Brak River in the district of George. I consider it to be contemporaneous with the clayslate."—Ba in, p. 180. Though Mr. Bain is correct as to the corelation of the gneiss and the granite, the section at Sea Point disproves the passage of the former into the clayslate. Not only is the gneiss unconformable to the clayslate, the latter being vertical, while the former is as horizontal as the rock surface will permit, but the abraded character of that surface proves, that, the periods elapsed between the deposition of the Silurian and Gneiss; one ranging from the time of its deposition to its upheaval, and a second period reaching thence until the gneiss was formed. And judging by the smoothly worn appearance of the face this second period was not a brief one.

The Granite of the Table Mountain Range presents one feature, which is almost unique even for this rock, which presents so great a variety of physical appearances, as well as lithological structure. We refer to the fact that it once must have covered a not inconsiderable area of the adjoining sedimentary clayslates. This phenomenon is best studied on the shores of Green Point, where evidence of it can be examined in numerous sections, views of which are now before you; some of the specimens which lie on the table will still further assist us in realizing the matter. Most of these specimens have been taken from the shore beds which lie to the a little westward of Sea Point Cottage, the residence

of H. Solomon, Esq. Right opposite Mr. Solomon's flagstaff, on the beach, may be seen a layer of a somewhat coarse-grained granite overlying the sedimentary rock (See Specimen A). This layer of superficial granite commences at nothing, at the distance of a few yards above high water mark, but rapidly thickens as it passes under the sea. The surface of the subjacent rock bears all the evidences of having been water-worn, and the superincumbent granite has insinuated itself into every hollow and crevice. At little further east, and at a spot which is present almost entirely covered by the low tides, is another outlier of granite, which also appears to thicken in a northerly direction, that is, under the sea.

As we have already intimated a marked change has been effected in the sedimentary rocks lying below the granite. They have been rendered highly crystalline. Both the chief component ingredients, or the *material*, as it were, of which the bulk of the rock has been formed, and the cementing medium, silicic acid, have been crystallized. The former appears in separate aggregated crystals, while the latter has assumed the appearance of branching forms; both the crystals and the reticulated forms lie, as a rule, parallel to the plane of the deposition of the original beds. (See Specimen X.) This peculiar crystalline appearance, coupled with the direction of the master joints, clearly proves that these beds of sedimentary origin have been metamorphosed, and in the absence of all other agents we must conclude by the superincumbent granite. This metamorphosed character is therefore a fair guide to the extent of surface which had at one time been covered by the granite; in other words, wherever this peculiar form of metamorphic change is now seen, although other rock lies near at the present day, we may fairly conclude that it was once covered by the adjacent granite, and if this view be a correct one, the granite rock must have originally overlaid the older Silurian rock to a distance of more than half a mile from the edge of the great granitic mass. There are, however, two ways of looking at this correlation of the granite and clay slate. Those who believe granite to be itself an altered stratified rock, would at once overcome the difficulty by considering that it had been deposited

in its present situation by water, and that it had been subsequently metamorphosed into its present crystalline condition. This theory does not agree with the difference in the planes of stratification, if one may say that granite has plane a of stratification. Curiously enough, this view is apparently supported, if not greatly confirmed, by a mass which forms itself into a bold rugged little headland a short distance to the west of the spot where the granite was seen directly overlying the metamorphosed sedimentary rocks. The rocks composing this little headland are to all appearance bedded; and their bedding too is conformable to that of the sedimentary rocks below.

On proceeding still westward, across the little bay which is bounded on the east by these last mentioned beds, and coming nearer the great central granite mass, another phase of the same rock is seen. Here, a little quarry gives a good section, showing gneiss resting on the sedimentary rocks, following the various inequalities of their worn surface. Over the gneiss again comes coarse crystalline granite. (See Specimen C). Whatever it may be elsewhere, there is no great thickness of gneiss at this place. Here too, one sees how the two rocks gradually pass into each other.

The gneiss rests unconformably on the metamorphosed clayslate, and is of that kind which is generally considered as gneiss proper, passing into mica schists. I have seen no porphoritic gneiss ortycuile in the colony. As is commonly the case it is hard, tough, and crystalline, showing the curves and flextures of its stratification in a marked degree. And though in the main Gneiss may belong to any age, the time of the deposition of the rock under our notice is fixed by the surrounding formations. Its plane of deposition lies at right angles to that of the clayslates below. Higher up it become coarser-grained, until it resolves itself into granite, containing large crystals.

A more instructive section can scarcely be found. True it is on a small scale, but the lessons it teaches are none the less interesting, on that account. And they are as follows:—After the upheaval of the clayslates there was a period of rest, during which the adjoining granite was sorted by water, and the resulting gneiss laid over the previously water-worn shore beds.

Then came a period of commotion and unrest, in which the gneissic sediment, in common with a considerable area, of the adjoining Silurian rocks became covered with freshly erupted granite. But no disturbance of the gneiss-covered strata accompanied this outburst, for the gneiss shows no sign of fracture, or of displacement. Then came a long period of subsidence; during which the Silurian hills were submerged beneath the sea level, and became covered over with the Table Mountain Sandstones; and lastly, by a general upward movement, these were again lifted high out of the ocean.

Most of the usual minerals accompanying the granite are found at Sea Point. Good hand specimens of black obsidian are found on the slopes of the Table Mountain. Large crystals of tourmaline are frequently left in the partially-decomposed very coarse granite. Talc of moderate size is occasionally seen. The slopes of the hills above a certain height are covered with immense deposits of decomposed felspar in the form of kaolin, much of which is of sufficient purity for the manufacture of porcelain. Trachite occurs in a few places, as at Sea Point. Here other lodes of pyrolusite or the peroxide of manganese are found either in the granite or at the junction of the granite with the overlying sandstones.

Nor is it uninteresting amidst all these and many subsequent changes to find the continuity of life on the globe such that the very same waters which deposited those far-off Gneissose and Devonian beds and those which wash our shores this day, contain one and the same organism. The modern terebratula of Sea Point is scarcely distinguishable from its patriarchal fossil Devonian prototype. This shell has come down in an unbroken line from the youth of the earth to these latter days.

The granites of Sea Point, in common with those of the Paarl, are of the usual typical kind, and composed of quartz, felspar, and mica, arranged in distinct grains or crystals. It is highly crystalline. It presents no traces of deposition or stratification, but varies from a fine to a very coarse-grained kind.

But to proceed a little further east comes the great mass of protruding granite. It rises in mountain masses, giving that peculiarly bold appearance to that singular hill, the Lion's Head. On the eastern side of

the granitic wall, the clay slate beds are seen to be in an almost vertical direction, while both the plutonia and the sedimentary rocks are crowned with the horizonctl red sandstone beds.

Let us now endeavour to trace the connection which may have existed between the protruding granite and the present upturned position of the adjoining clay-slates; and especially, as to whether their now high inclination is solely due to the extrusion of this plutonic matter, or whether we have to seek for some other cause of the change from the horizontal to the vertical from. The first consideration is that of the quantity of matter to be upheaved; that is, supposing the granite to have been the primary and sole agent in uplifting the beds from their once level position to that on edge, how great a depth of beds had to be overturned. These clayslates are at least two miles thick, and during the whole of the two miles the component beds have a very high angle. It is scarcely probable, or even possible, for any force acting at any one spot or along an axis of hundreds of miles to have the power of changing the plane of inclination from the horizontal to that of 90° for a depth of two miles—to have changed or rather overturned strata two miles deep, so that they might stand on edge. It is impossible to conceive of any force, acting with such an unrigid leverage as that of rock matter, being able to so revolve, as it were, on a hinge such an enormous mass of matter. Besides, an eruptive force is more of a shattering, a riving, than an uplifting, or an overturning power. To effect such a complete change in the position of strata over a large area so as to place them on edge, the uplifting force must act under much, or the whole, of the said strata. And even then there must be a free end, to permit of the swinging action, for no overturning can occur without considerable room. A shattering results instead. Besides an irruptive action, like that of granite, can only be exercised on one spot, and vertically upwards, and could not by any possibility have operated over large areas.

We do not mean to say that the extrusion of so much granite had not an effect and a great effect, though an indirect one, on the conversion of the clayslates from their original horizontal position to the vertical one which they now occupy. That the granite had much to do in this

matter is evident from the fact that the axis of the line of dislocation of the clayslate is parallel with that of the granite; the same might be said of the axis of the adjoining synclynals and anticlynals on either side. The probable series of operations were the following. The intrusive force, acting vertically upward, would remove away a sufficient portion to permit the molten matter to issue forth. A fissure would then be created equal in width to that of the issuing granite. In time, as the molten matter continued to issue forth the superficial beds would be weakened more and more until at last they would fall in like the flat roof of a house, and would stand at a greater or less angle of inclination.

A knowledge of the fact that the granite covers the sedimentary rocks has some importance from a utilitarian point of view. Water is certain to be flowing through the small interstices which invariably occur between the two rocks. If, therefore, the granite be bored through, this supply of water would be recovered. Fountains would greatly enhance the value of lands which lie too high on the hill side, as at Sea Point, to obtain water from the waterworks.

A still newer eruptive rock than the granite appears a little this side of the Clifton Hotel, on theside of the Kloof-road, in the form of a dyke of Greenstone. It is easily distinguished from the surrounding granite by its colour and form.

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R. Trimen, Esq., F.L.S., F.Z.S., M. Ent. Soc., Lond., *General Secretary.*
H. E. R. Bright, Esq., F.G.S.
L. Dale, Esq., M.A., LL.D.
J. Fforde, Esq.
J. G. Gamble, Esq., M.A., M. Inst. C.E.
F. Guthrie, Esq., LL.B.
The Hon. J. X. Merriman, M.L.A.
J. Sivewright, Esq., M.A.

* The Rules of the Society provide that the President's office cannot be held by the same person for more than two years consecutively.

LIST OF MEMBERS

OF THE

SOUTH-AFRICAN PHILOSOPHICAL SOCIETY

ON THE 31ST DECEMBER, 1879.

Ordinary Members.

Abercromby, A., M.D.
Arderne, H. M.
Ayers, F.
Bain, T.
Barry, J.
Bindley, Rev. F. W.
Boettger, G.
*Bolus, H., F.L.S., *Treasurer.*
Branford, E.
*Bright, H. E. R., F.G.S.
Buchanan, E. J.
Burrowes, F. W.
*Dale, Dr. L., M.A.
De Smidt, A.
De Smidt, W., jun.
De Villiers, Sir J. H., Kt., C.J.
De Villiers, J. H.
Dickson, W. W.
Dunn, E. J.
Du Preez, H. P.
Eaton, C. B.
Ebden, Hon. A., M.L.C.
Ebden, Dr. H. A.
Ebden, J.
Fairbridge, C. A.
*Fforde, J., C. E.
Fisk, Rev. G. H. W., C.M.Z S.
*Frere, H. E., Sir Bartle, Bt., F.R.S.,&c., &c., *Vice-President.*
Friedrichs,
Finlay, R.
Fuller, T. E., M.L.A.
Fuentes, F. S.
*Gamble, J. G., M.I.C.E.
*Gill, David, F.R.A.S., *President*
Glynn, R.
*Guthrie, F., LL.B.
Hahn, Dr. D.
Hawthorne, W. T.
Jenour, A. C.
Jerram, S.
Kitching, Dr. C. W., M.B.
Kilgour, G., M.I.C.E., F.R.G.S.
Knox, E. B. J., Assoc. I.C.E.
Lightfoot, Rev. Canon, B.D.
Lippert, W. A.
Littleton, The Hon. W. F., C.M.G.
McGibbon, J.
McLoughlin, P.
Marquard, L.
Martin, P. D.
Matson, R. B.
*Merriman, Hon. J. X., M.L.A.
Moore, W. E.
Morgan, C. Lloyd.
Noble, J.
Ogilvie, Rev. Canon, M.A.
Palgrave, W. C.
Redelinghuys, J. H.
Risler, Capt. T.
Rutherfoord, F. F.
St. Leger, F. Y., B.A.
Saunders, J.
Scanlen, T. C., M.L.A.
Southey, Hon. R., C.M.G.
Schunke, H. C.
Shaw, Dr. J., F.L.S.

These marked * are the present Members of the Council

Silberbauer, C. F.
*Sivewright, J., M. A., C.M.G.
Smith, Hon. C. Abercrombie,
Solomon, S., M.L.A.
Stagg, Capt. G. E. O.
Stegmann, Rev. G. W.
Stevens, C. M.
Stewart. Dr. J. G.
Tennant, H., M.L.A.
Theal, G. McColl.
*Trimen, R., F.L S., F.Z.S., *General Secretary.*
Tweed, A.
Upington, Hon. T., Q.C., M.L A.
Wessels, J. C.
Wiener, J.
Wilson, R.
Whitton, J.
Watermeyer, B.

Corresponding Members.

Arnot, D., F.L.S.
Barber, Mrs.
Bowker, Col. J. H., F.Z.S., F.R.G.S.
Buchanan, Hon. J.
Callaway, Rt. Revd. Bishop.
Cohen, Emil.
Exton, H., M.D.
Gooch, W. D.
Holub, E., M.D.
Lanyon, Sir Owen., K.C.M.G.
McOwan, P.
Payn, F. P.
Stent, Sydney.
Warren, Col. Charles., R.E., C.M.G.

These marked * are the present Members of the Council.

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Wednesday, 27th November, 1878.

Ordinary Monthly Meeting.
Mr. Bolus, Vice-President, in the Chair.
Eight Members present.

Mr. H. E. R. Bright exhibited some minerals from Damaraland, which had been sent to him by Mr. Palgrave, and made some remarks on the Geology and Mineralogy of that district.

Mr. R. Trimen exhibited specimens of two species of *Nycteribia*, a genus of apterous insects only found as parasites upon certain Bats, and referred by entomologists to the order of Diptera. One species was of unusually large size, and had been taken from a small Bat, *Miniopterus Schreibersii*, inhabiting the so-called "guano" caves near Montagu.

Mr. Trimen also exhibited a pair of the singular cricket of the genus *Anostostoma*, which is found near Cape Town. The male cricket is most remarkable for the extraordinary size and form of the mandibles and other organs of the mouth.

Some rare South African Lepidoptera, exhibited by Mr. Trimen, included *Papilio Antheus* and *Lophostethus Dumolinii* from Port Natal, and *Acræa Rabbale* and *Charaxes Castor* from Delagoa Bay.

Wednesday, 29th January, 1879.

Mr. H. Bolus, Vice-President, in the Chair.
Sixteen Members and four Visitors present.
The following gentleman was declared duly elected :—
George McColl Theal, of Alice,
as Ordinary Member.

Mr. Dunn made some remarks on the Coal of the Camdeboo and Beaufort West.

In the discussion which ensued, Messrs. Bright, Knox, Bolus, and Guthrie took part.

Mr. C. M. Stevens exhibited some Bushman drawings sent to the Society by Mr. Lycett, of Worcester, in response to the invitation of the Society. The Secretary read Mr. Lycett's letter, containing a promise of copies of drawings from a cave believed to be hitherto unvisited.

Mr. Schunke read a paper on the Geography of a part of South-West Africa.

Mr. Mitchinson, a Visitor present, who had recently returned from part of the district described, made some observations on the subject.

A general discussion ensued.

Wednesday, 26th March, 1879.

Mr. H. Bolus, Vice-President, in the Chair.

Six Members and one Visitor present.

In consequence of there not being a sufficient number of Members present, the election of Members nominated last meeting was deferred.

Mr. Dunn exhibited a collection of stone implements collected in various parts of the Colony, and made some remarks thereon.

Mr. W. H. Piers read a paper on the Geology of British Kaffraria.

Wednesday, 30*th April,* 1879.

In the absence of the President and Vice-President, Dr. Dale was elected Chairman.

Eight Members present.

In consequence of there not being a sufficient number of members present, the gentlemen nominated at the two last meetings were not elected.

Notice of motion of an amendment in the Rules of the Society was given by the Secretary as follows:—

"That Rule 8 of the Society be amended so as to read as follows:—

"The President and Council for the ensuing year shall be elected from among the ordinary Members as follows:—

"The Meeting shall by open vote appoint Scrutineers, and shall determine the time at which the election shall close.

"Every Member present desiring to vote shall hand in a list of names, one as President, and not more than ten as Members of Council, and shall sign the same.

"The Scrutineers shall mark off from a list of Members with which they shall be provided the names of those who have handed in voting papers; and after

the election has been closed the Scrutineer shall make a report showing the number of votes given for each person, and the Chairman shall declare those having the greatest number to be duly elected. But in the event of a tie, a fresh election shall be held in respect of such names only until a complete Council be elected.

"In the event of a tie occurring a second time between the same names, the election shall be by lot."

"That Section III. of the Bye-Laws be repealed.

"That in Section V. of the Bye-Laws paragraphs 6, 7, 8, 9, be abolished, and the following substituted:—

"The Meeting shall proceed to the election of a President and Council, according to Rule 8 of the Society."

Wednesday, 28th May, 1879.

Mr. Bolus, Vice-President, in the Chair.

Twelve Members present.

The following gentlemen were declared duly elected:—

Francisco Solano Fuentes, Esq., of Cape Town,
W. W. Dickson, Esq., of Cape Town,

as Ordinary Members, and

William Daniel Gooch, Esq., of Durban, Natal,
Philip Francis Payn, Esq., of Durban, Natal,

as Corresponding Members.

Proposed by Captain Risler, and seconded by Mr. Trimen:—That the Council be requested to consider the desirability of taking steps to welcome David Gill, Esq., F.R.A.S., Astronomer-Royal, upon his arrival in this Colony, and of inviting him to become a Member of the Society."

Carried.

Proposed by Mr. Merriman, and seconded by Mr. Fforde:—That the Eighth Rule of the Society be amended as follows:—

"That the President and Council for the ensuing year shall be elected at the annual meeting, to be held during the month of July, from among the Ordinary Members as follows:—

"The Meeting shall by open vote appoint Scrutineers,

and shall determine the time at which the election shall close.

"Every Member present desiring to vote shall hand in a list of names, one as President, and not more than ten as Members of Council, and shall sign the same.

"The Scrutineers shall mark off from a list of Members with which they shall be provided, the names of those who have handed in voting papers; and after the election has been closed the Scrutineer shall make a report showing the number of votes given for each person, and the Chairman shall declare those having the greatest number to be duly elected. But in the event of a tie, a fresh election shall be held in respect of such names only until a complete Council be elected.

"In the event of a tie occurring a second time between the same names, the election shall be by lot."

Carried.

Proposed by Mr. Trimen, seconded by Mr. Fisk:—
That Section III. of the Bye-Laws be repealed with the exception of paragraph 4.

Carried.

Proposed by seconded by
That in Section V. of the Bye-Laws, paragraphs 6, 7, 8, 9 be abolished and the following substituted, viz.:—

"The Meeting shall proceed to the election of a President and Council according to Rule 8 of the Society."

Carried.

Wednesday, 30th July, 1879.

Ordinary Monthly Meeting.
Mr. Bolus, Vice-President, in the Chair.
Twenty-one Members present.
The following gentlemen were proposed:—
The Hononrable W. F. Littleton.
David Gill, Esq., F.R.A.S., Astronomer Royal.
The Honourable C. Abercrombie Smith.
R. Finlay, Esq.
as Ordinary Members.

Proposed by Mr. A. Ebden, seconded by Mr. Branford:—That Rule 5 of the Society be suspended for the purpose of proceeding to the immediate election of the gentlemen just nominated.

Carried unanimously.

Proposed by Mr. J. W. Ebden, and seconded by Mr. F. S. Fuentes :—That the above-named gentlemen be elected Members of the Society.

Carried unanimously.

Wednesday, 30th July, 1879.

Annual General Meeting.

Mr. Bolus, Vice-President, in the Chair.

Twenty-one Members present.

The General Secretary read the General Report of the Society for the past year, and the Report of Mr. C. M. Stevens, Secretary of the Ethnological Section.

The Treasurer read the Financial Report.

Report of the Proceedings of the South African Philosophical Society for the year ending 30th July, 1879.

Since the last Annual Meeting of the Society on the 26th July, 1878, nine Ordinary Monthly Meetings of the Society have been held, and seven papers read or addresses delivered, of which one related to Geography, one to Geology, two to Native Arts and Customs, two to Botany, and one to Mathematics.

The second part of the transactions of the Society has been published, and materials are now in hand towards a third part, which it is trusted will contain communications not only of interest to the Members of the Society but of intrinsic scientific value.

At a Meeting of the Council held on 14th October, it was resolved to publish a Catalogue of Scientific Works relating to South Africa, and the gentlemen whose names are given below have kindly undertaken to compile the following sections of this catalogue.

Zoology, Mr. Trimen,
Botany, Mr. Bolus,
Geography, Mr. Schunke,

Ethnology, Dr. T. Hahn,
Meteorology, Mr. Gamble,
Geology, Dr. D. Hahn,

The Botanical section by Mr. Bolus and Professor McOwan, of Gill College, Somerset East, is now almost ready for publication, and some of the other sections are considerably advanced.

The utility of such a Catalogue to present and future students of these branches of science as connected with South Africa will hardly be questioned.

A valuable contribution to the transactions of the Society has recently been made by the Rev. C. G. Büttner, entitled "Contributions to a Comparative Dictionary of the Bantu Languages, consisting of a comparison of words in ninety-four different dialects."

It is to be regretted that the communications to the Society during the year have not been more numerous and varied, but it is to be hoped that during the ensuing twelve months more satisfactory results may follow from the zeal of the Members and their friends.

During the year thirteen new Ordinary Members and six new Corresponding Members have joined the Society, and eleven Members have either died, left the Colony, or formally resigned.

The Society have again to thank the University for its permission to use the University Hall for its meetings.

Certain alterations have been made during the year in the Rules and Bye-Laws of the Society with a view to facilitate the election of the President and Council.

F. GUTHRIE,
General Secretary.

Report of the Secretary of the Ethnological Section.

Cape Town, 30th July, 1879.

When the motion was carried for the formation of an Ethnological Section of the South African Philosophical Society, the Council did me the honour of appointing me the Honorary Secretary of this the first section formed in the Parent Society.

I accordingly prepared a circular setting forth the objects aimed at, which I distributed to all names I thought likely to take an interest in the movement, requesting their kindly co-operation.

A short time subsequently, upon representations from the Council, the Government was pleased and liberal enough as to grant the concession of free postage on letters and parcels franked for this service.

Notwithstanding these facilities I regret to report that but little response has been made to the Circulars thus distributed over the country.

In one case I received an acknowledgment of the Circular and a promise of assistance did chances permit and opportunities offer.

The only case of real practical interest to report is that shown by Mr. Lycett, of Worcester, who readily responded to the invitation of the Society by undertaking long and toilsome visits to caves and rocks in the district of Hex River, and taking tracings of the Bushman paintings still extant, as well as organising a party to carry a camera in order to take photographs of the rocks with the paintings on them as they are. The tracings received by me were exhibited to the Society at the monthly meeting in January last. I received subsequently some photographs of the same group of tracings and some pieces of broken potting from the same locality. Yesterday, Mr. Lycett was again good enough to forward some more tracings, which are for exhibition only, and which he desires to have returned at an early date. It is my purpose to ask his permission to make copies of these drawings before I return them.

CALLCOTT M. STEVENS,
Hon. Sec. Eth. Sec., S. A. P. Society,

FINANCIAL REPORT OF THE TREASURER OF THE YEAR

DR. *The Treasurer in Account with the*

		£	s.	d.
1878.				
July 1st	To Balance in Standard Bank...	128	12	10
1879.				
	To Subscriptions received viz :—			
	2 Members to 1st May, 1879 ...	4	0	0
	69 „ „ 1st July, „ ...	138	0	0
	7 „ „ 1st Oct., „ ...	14	0	0
	3 „ „ 1st Jan., 1880 ...	6	0	0
	3 „ „ 1st April, „ ...	6	0	0
		296	12	10

We, the undersigned Members of the South African examined the above account, and the accompanying Balance of £276 3s. 6d. as per Pass Book in the

Memo of Liabilities :—

Juta, for printing Transactions about ...	62	13	6
W. Foster & Co. printing and advertising	4	3	6
W. T. O'Callaghan, lighting	0	12	0

SOUTH AFRICAN PHILOSOPHICAL SOCIETY FOR THE 1878-79.

South African Philosophical Society. CR.

1878.	£	s.	d.	£	s.	d.
By Expenses Attendance:—						
Aug. 2. Paid Coskey	1	10	0			
Sept. 30. „ „	1	0	0			
1879.						
Feb. 3. „ „	1	7	6			
May 1. „ „	0	17	6			
By Expenses Copying:—				4	15	0
Aug. 9. Paid E. Hogge				1	1	0
By Expenses Lighting:—						
Aug. 17. Paid Callaghan ...	3	0	0			
1879						
Mch. 25. „ „	3	17	0			
				6	17	0
By Commission on Collecting Subscriptions:—						
Sept. 30. Paid Coskey	2	5	0			
1879						
Feb. 3. „ „	1	1	0			
May 1. „ „	0	9	0			
By Printing and Advertising:—				3	15	0
Oct. 18. Paid W. Foster & Co.	1	1	0			
1879						
Mch. 21. „ Cape Times ...	0	18	0			
May 16. „ Argus	2	2	4			
				4	1	4
By Balance in Standard Bank				276	3	6
				£296	12	10

HARRY BOLUS, *Treasurer.*

Cape Town, 28th July 1879.

Philosophical Society, do hereby certify that we have vouchers, that we find the same to be correct, and the Standard Bank.

M. A. LIPPERT,
L. WIENER. } *Auditors.*

These reports were adopted.

With a view to the election of a President and Council for the ensuing year, Messrs. Trimen and Fforde were chosen as Scrutineers.

The result of the election was that the following gentlemen were elected.

David Gill, Esq.. F.R.A.S., as President, and His Excellency Sir Bartle Frere, and Messrs. Guthrie, Bolus, Trimen, Bright, Dale, Sivewright, Gamble, Fforde, and Merriman, as Members of the Council.

At 3·30 p.m. His Excellency, the outgoing President, delivered the annual address, which treated of what the Society had accomplished since its institution, and in what directions its further efforts might with most advantage be made.

Mr. Gill moved a vote of thanks to His Excellency, which was carried unanimously.

Annual Address to the South African Philosophical Society, delivered on July, 29th, 1879.

His Excellency the Governor having congratulated the Society on having elected as their President the Astronomer-Royal, and expressed his regret at his own absence from their meetings for so long a period; reminded the Members present that the Society was constituted on June 22nd 1877, when its objects were declared to be "To promote original research and record its results, especially as connected with the natural history, physical condition, history, geography, statistics, industrial resources, languages, and productions of South Africa." The 18th rule of the Society required that at the annual meeting the President for the past year, or, at his request, some other person to be nominated by the Council of that year, should deliver an address on some subject connected, if it were possible, with the objects of the Society. The President's absence having prevented his preparing any address on any of the subjects above specified, he had applied, successively, to two gentlemen of high position and well qualified to deliver a suitable address, such as the rule required; but in both cases he had found that other official engagements were an

obstacle to compliance with the request. Under these circumstances it appeared to him that perhaps the most useful address he could deliver to the Society at the present moment would be to review briefly what the Society had done during the two years of its existence, under each of the heads of inquiry indicated in its rules, and to note the directions to which further attention might be usefully directed by Members of the Society.

Taking, then, *Natural History* as the first head of inquiry, he found five papers, all of considerable interest, namely Dr. Shaw's paper on *Roridula Dentata*; one on the Insectivorous Plants at the Cape; a note on the Colorado Beetle, and another on the so-called "bonnet" of the Southern Right Whale, both by Mr. Trimen; a paper on the peculiar colours of animals in relation to their habits of life, by Mrs. Barber; and a paper, as yet unpublished, but which would probably appear in an early number of the Transactions, on the geographical distribution of plants in South Africa, by Mr. Bolus.

Under the second head, namely the *Physical Condition of South Africa*, which of course was a very wide class, there were nine papers; Dr. Shaw's on the Age of Volcanic Throats of the Upper Karoo formations, a useful geographical and geological sketch; a paper on the movements of Sea Sands and Bar Harbours, by Mr. Piers; three papers by Mr. Prosser, namely, notes on the Devonian and Ash Beds of the Karoo and Gough, one on the Granites and Gneiss of the Colony, and another on the Limestones; Mr. Guthrie's note on the Heat of the Sun in South Africa; Mr. Gamble's on the Rainfall; a valuable paper or note of what is required in order to investigate further Meteorological questions of great practical importance; a note on the Geology of Fort Beaufort district, by Mr. Piers; one on the Petrography of Table Mountain Valley, by Dr. Shaw; and an unpublished paper, by Mr. Dunn, which will appear in the next volume of the "Transactions," on Stone Implements found in the Colony. This paper is illustrated by wood engravings which reflect great credit on the local artist who has executed them.

Under the heads of *History, Geography, Statistics*, the President regretted that we had, as yet, no papers.

Under the head *Industrial Resources* were two papers, both of much importance; one by Mr. Sivewright, on

the Trans-African Telegraph, and the other, by Mr. Guthrie, on Continuous Girders, Arched Ribs, and Tension Circles.

Under the head *Languages* there was but a single paper by Mr. Stevens—Remarks on Clicks or an Investigation of the Etymon of some South African Geographical Names.

Under the head *Traditions* was an interesting paper by Commandant Griffith,—Observations on Witchcraft in Basutoland, which was read by Mr. Merriman.

In considering the work done under this head by the Society, it ought the President said to be mentioned that the Folk-Lore Society may be regarded as a result of the Society's existence. The Folk-Lore Society appears to be an active and useful offshoot, and we may hope will give permanence and circulation to many contributions relating to this branch of the Philosophical Society's proposed labours. It may also be mentioned, under the head Natural History, that, partly through the Society's intervention, the publication of the "Flora Capensis," long suspended, has been resumed.

Besides the more formal papers read and printed, there have been many verbal communications of interest made to the Society, chiefly in reference to specimens brought to meetings for exhibition, such as those of Dr. Shaw and Mr. Bolus respecting plants, Mr. Bright, Mr. Dunn and Mr. Prosser in regard to rocks and minerals, Mr. Bain respecting fossil remains, the Rev. G. Fisk respecting reptiles, and of Mr. Trimen in the way of insects.

Such has been the work of the Society during the two years of its existence. The Society may be congratulated upon, the President thought, a very fair measure of success, considering the obstacles raised by the disturbed condition of the country generally.

Referring next to what may be reasonably expected of the Society under each of the heads of its inquiries, the President said he would mention a few of the desiderata—not an exhaustive list, or in any scientific order, but simply a memorandum of what it was in the power of almost any member to supply if he made use of the opportunities offered to the scientific student in South Africa.

Turning first to *Natural History*, it is he said evident that a vast field remains open for inquiry and discovery in the

Botany of South Africa, both as regards new species and their distribution. As an example of the new fields of investigation still open, the President mentioned the labours of his predecessor Sir Henry Barkly; and of Mrs. Barber, who had added much to botanical knowledge of the Stropelias; and His Excellency referred also to Dr. Shaw as able to testify to the amount of discovery that was still accessible, even to active men of business in the capital itself. It was probable also that many valuable discoveries mightbe made regarding the medicinal and economical uses of plants by any one who would collect and test what was known to the natives and to colonists who, residing far from chemists' shops, were forced to make the best use they could of such natural remedies as lay within their reach. Little was yet known of the native poisons used by the Bushmen for their arrows, some of which were of vegetable origin, and were probably extracted from plants of great medicinal importance. As regards insects, members of the Society need only ask the Secretary, Mr. Trimen, to show them the beautiful collection of insects, many of them new to science, lately presented to the Museum by Commandant Bowker, as the acquisitions of a single year's travelling, to feel convinced of the the immense number of new objects which might reward the diligent collector.

Under the head of *Zoology* there was a wide field of investigation still open. Most of the larger game had been fully described, and their extinction placed it out of the power of most colonists to tell us much more about them. But there are still new species of the smaller animals and birds, the discovery of which occasionally rewarded the careful observer. It is probable that here, as elsewhere in thinly inhabited countries, the smaller animals and those of nocturnal habits are still imperfectly known. Then, with regard to species already described there is much to be learned respecting their habits. The President instanced the common Ant-bear or Ardvark, an animal by no means uncommon, but, from its nocturnal habits, rarely seen; and he related many particulars of one which was kept for some time by the Lieutenant-Governor of Natal. It was visited in captivity by numbers of people who had never seen an Ant-bear before, though they must have been daily passing the burrows excavated by these animals in almost every field

in Natal. He mentioned also that he had searched in vain in books of natural history for a minute account of the habits of Cape moles, such as he had heard related one afternoon by Dr. Dale. The habits of the meer-cats, which are common everywhere in the colony, appear to be little known, except from specimens in confinement; and the same is the case with the Nacht-aapies (night-apes or lemurs) found to the north of the Transvaal, and with a species of dassie, allied to the common rock-rabbit, which had been found by Dr. Atherton in the forests between Algoa Bay and the Bushman's River. Again, there is much to be learned regarding the present distribution and extirpation of well-known forms. For instance, the hippopotamus. The President mentioned that he had heard very interesting accounts of the last hippopotamus seen in the Berg River, near Mr. Melck's farm, as well as of those in the Buffalo, St. John's River, and the Tugela, where they had been common within the last few years. He referred also to the fact that he had heard stated, by sportsmen of experience in Natal, that the hippopotamus frequently travels from the mouth of one river to another, through the surf on the sea-shore, taking refuge either on land or in the water as indications may render necessary; and thus, possibly, extending its range to rivers difficult for an animal to reach which habitually keeps so close to the river-bank. The history of the last elephant or last buffalo seen in a forest must be worthy of preservation, as well as a record of the circumstances under which they continue to exist in a few of the colonial forests, such as the Knysna, the Kowie, and the Addo Bush. Again, with regard to some of the best known antelopes—the springbok, for instance—we know little of the causes of those migrations: how far dependent on seasons or other causes. Tigers, as they are called, or panthers, from their migratory habits, appear to have a better chance of survival than the hyena, wild-dog, or even jackal, which have almost disappeared in many parts of the country in consequence of having been poisoned by shepherds. Where this has been effected, it would be useful and interesting to observe and describe the results, in destroying the natural balance of animal life, leading, to an increase of the animals on which the carnivora formerly preyed.

As regards snakes there is a vast and attractive field of inquiry open in all parts of South Africa, and for all who travel beyond the colonial boundary there is still much to be learned respecting alleged differences of species in such well-known forms as the rhinoceros and lion.

For the naturalist of a more practical turn, how much may yet be done and learned regarding the possible acclimatisation of useful plants or animals. The history of the introduction of the merino sheep, the Angora goat, &c., would afford materials for many an interesting and useful paper, as would also the preservation and partial domestication of the ostrich; whilst the sportsman and naturalist would read with interest accounts of what had been done or could be effected for preserving some of the nearly extinct breeds of antelopes. The possible domestication of the African elephant, and of the introduction of such animals as the camel, Mama or alpaca, would also afford materials for useful study.

Mr. Trimen is the President continued able to assure us how much yet remains to be done in the department of Entomology. Many inquiries in this direction might have most important practical results; such, for instance, as inquiries regarding the Tsetse-fly, its habits, and a possible cure for its bite, as well as experiments as to whether it be really such a serious obstacle to travellers as have been represented. Inquiries of this kind must result in making easily passable many belts of country which, at present, form a formidable obstacle to the traveller and trader.

The Ichthyologist will find, both in our coasts and in our rivers, much room for fresh discoveries, and the President had been assured, by one of the highest authorities in Europe, that the fish and marine zoology of the L'Agulhas Bank are, as yet, but little known.

In parts of the Transvaal, as at Wonderfontein near Potchefstroom, streams are found in the vast underground caverns which have never been thoroughly explored, and it is possible that fresh species of proteus, or some analogous animal, might reward the researches of careful observers. An interesting paper by Mrs. Barber, which appeared sometime ago in the *Cape Monthly Magazine*, will prove that even the earthworms of the Colony may reward the intelligent observer with new facts of much interest.

Under the head of *Physical Condition*, the field of

inquiry is practically boundless. Much that is open to the Geologist relates to the mineral wealth of almost every part of South Africa. It is possible that others besides the President himself had looked on the geological and mineralogical notes on the face of some of our best modern maps of the Transvaal as little better than the advertisements of the land-speculator; but he had found that as regards Mr. Jeppes valuable map, and that of Bain's, the statements so recorded did not in way over-estimate the mineral resources of the country. At several places from Newcastle to Heidelberg he found coal in common use, obtained from surface-diggings close to the road, and between Potchefstroom and Kimberley he passed five wagon-loads being carried for nearly 300 miles and sold, at after all, a fair profit at the Diamond-fields. In like manner, he met wagons containing about eight tons of lead just obtained from Mr. Bray's mines, and being hawked about the country. Such facts as these, to say nothing of gold, diamonds, cobalt, or copper, show what a wide and valuable field is open for the practical geologist or mineralogist.

Among scientific facts, which will all be of great practical value hereafter, may be mentioned the volume and discharge, at different seasons, of water in our great rivers. The time cannot be far distant when engineers will turn their attention to the formation of canals on a large scale from the great rivers of the interior, and careful observations regarding the quantity of water any river has carried through a series of years will hereafter be invaluable in the calculation of possible irrigation works and their results.

So with regard to meteorology. Mr. Gamble's paper, already in the Society's records, shows the great want of careful, continued, and systematic observation regarding rainfalls, &c. The Royal Observatory here affords every facility for collecting, correcting, and systematising such observations, and occasional papers, noting the results, would be a valuable addition to the Society's transactions.

Under the head of *History*, the Society's transactions are at present a blank; but there is an infinite field for inquiry and record of historical data regarding native tribes and their migrations. The President had never been able to

meet with even a tradition of the Kafirs, which went back for more than ten generations. They, he observed, say themselves that they came from the North, and the old Dutch and Portugese maps, though far from accurate, place them obviously to the North of their present position; but further inquiries, and comparisons of names of places and rivers may throw much light on the questions whence they came and whether they are a people who has descended from a higher state of civilisation, or a race which has been gradually emerging from a condition of greater barbarism.

Of modern history, and of what relates to the European races in South Africa much remains to be gathered. The records of the early colonial families, Dutch and Huguenot, are daily perishing, and hereafter will be of much historical and ethnological interest.

The history of the travels and sufferings of the "voortrekkers" are not only full of romantic interest, but of much political importance; and the colonial official records, which, would, His Excelleny hoped, now be cared for by such scholars as Dr. Van Oordt and Mr. Theal, would be found to exceed in interest even those of the fathers of the American Republic.

With regard to *Geography*, in which, at present, the transactions of the Society contain no papers, the President referred at some length to Dr. Holub's travels, and observed that we stand here as Dr. Livingstone considered, at the threshold of African discovery. We must not neglect either the Eastern or Western Coasts as channels for approaching the yet unknown portions of the continent; but the President expressed the opinion that Livingstone's first track showed the best and most convenient route for penetrating into the interior of Africa. He described the surprise with which he had learned the great amount of trade already existing between the Transvaal and the region drained by the Zambezi and its affluents. He mentioned having met several of those traders and travellers in the Transvaal, especially at Clerksdorp, a small township on the road from Potchefstroom to Kimberley, where, at the house of Mr. Leask, of the firm of Turner and Leask, he had found traders and travellers from the region of the Zambezi, who came there for a supply of winter goods needed for their hunting expeditions during the healthier

season. In the region drained by the Zambezi, and under Mr. Leask's hospitable roof, the President said he had found every refinement of modern civilisation at a point where two distinct regions of commerce adjoin each other, Mr. Leask's capacious warehouses affording storage to almost every article of trade imported at Algoa Bay as well as to the products of the far interior, wagon-loads of ivory, the spoils of the elephant, of the giraffe, of the rhinoceros, and of all the gigantic game animals of South Africa. Anyone meeting Mr. Leask's guests and availing himself of their ample stores of information regarding the countries to the northward might, in a few weeks, collect a vast amount of fresh geographical knowledge, and establish relations with enterprising travellers who, in hunting or trading, penetrate to regions as yet unknown to modern geographers. One of these gentlemen informed the President, that the year before last no fewer than between thirty and forty white men, traders, hunters, travellers, and missionaries, were assembled at Lo Bengula's capital; but the general purpose of Mr. Leask's vistors is business or hunting, and not scientific discovery. Clerksdorp would, however, afford an excellent outpost for travellers like Dr. Holub or Major Pinto, before commencing their travels, or as an advanced point whence to draw supplies.

At no distant period the exact position of the Southern Portugese frontier in this direction will require on political grounds to be ascertained with scientific accuracy, and the little we have as yet learned of Major De Pinto's discoveries during his recent extensive travels assures us that we may hope for results, from Portugese officials, not inferior to those which have been brought out by Dr. Holub, to whom the Philosophical Society were able to listen when delivering a lecture on the subject of his own travels.

Mr. Palgrave's reports lift, His Excellency said, the corner of the veil which has long shrouded the regions between the Portugese and English frontier of the Western Coast, and add considerably to the knowledge derived from the travels of Mr. Francis Galton, Mr. Andersen, and Mr. J. Anderson, and above all, of Livingstone, who led the way in this direction. All these, but especially Mr. Palgrave's reports, go to show the great practical value of further exploration in this direction, and there can be

no doubt that here, as elsewhere, anyone who would faithfully chronicle the experience acquired by the more advanced missionaries and traders at their stations beyond the boundary of civilisation might add immensely to the existing stock of geographical and other information regarding these regions.

The terrible sufferings of the Boers who, from three to nine years ago, have "trekked" from the Transvaal across the "Great Thirst Land" in search of a good pasture-region in the direction of Walwich Bay, afford a good illustration of the practical value of recorded geographical information regarding the so-called Kalihari "Desert." Had they been better informed on this subject, they could, no doubt have crossed this tract without the terrible sufferings which cost the lives of so many and involved the loss of property to almost all of the adventurous band of emigrants. It is clear that it requires only good guides and the means of obtaining water at a few feet below the surface to render the passage across the Kalahari safe in most seasons. The President gave reasons for his conclusion that the western frontier of the Transvaal affords the right path to the water-parting of Central Africa between the affluents of the Atlantic and eastern oceans, and that the belt of fever and tsethe infested country, which bounds the lake-region on the south, is narrower and offers less formidable obstacles to the traveller than either the eastern, western or northern borders of Central Africa. Our operations in Zululand have shown us how serious is the want of geographical knowledge regarding the countries North of Natal. There can be little doubt that had former travellers made better use of their opportunities, thousands of pounds and a considerable expenditure of life might have been saved during the last few months.

A good survey of the sea-coast, and an earlier publication of surveys made nine years ago in the Maputa River, which gives navigable access to the country sixty miles south of Delagoa Bay, would not only have been of great advantage to our troops in the field, but might for all time afford useful means of access for the trader.

Looking at the vast field of geographical discovery open to us in this direction, the President expressed the

hope that, in course of time, the Philosophical Society might be the means of securing to travellers like Dr. Holub the means of prosecuting their researches on terms similar to those on which grants are made by the Royal Geographical Society of London. The department of *Statistics*, His Excellency said, is like that of History, as yet a blank in the Society's transactions; and there are few departments in which there is more room for research, giving results of the greatest practical value. There are as yet, accessible to the general reader, few accurate data regarding the numbers and other particulars of the population, either Native or European, in South Africa. The statistics of the health and life of all classes are as yet most imperfect, and there is hardly a topic connected with statistical research on which papers of value to the student might not be contributed by members of the Society in almost any part of the Colony.

Under the head of Industrial Resources, we may note that everything regarding utilization of our mineral wealth, ores, building materials, materials for glass and pottery, and, above all, our gold-fields, require illustration. Of colonial woods, especially for cabinet purposes, little is known to any but those who have the means of making oral inquiries. Everything relating to the treatment of diseases of cattle and sheep, to the cleansing and packing of wool, to the industries connected with sugar and coffee in the northern colonies, are all of practical as well as of scientific interest. Possibly here is the place where we may express the hope that in future transactions of the Society we may have papers on the more exact sciences, and that the labours of the distinguished band of observers who have made the Cape Observatory so familiar to all astronomers may not be unnoted in the transactions of our Society.

Under the head of *Languages*, there is an almost limitless field for research and record of results. There must be among our members many who could assist philologists to follow Dr. Bleek's footsteps and aid Miss Lloyd in completing the work of his life. Among the appliances necessary to the student in South African philology, it is impossible to forget the treasures of the Grey Library; and we may hope that the action and influence of the Society will not be without result in

aiding to secure a qualified librarian for that noble collection.

Under the head of *Traditions*, as already observed, the Folk-lore Society affords convenient means of record, and of giving circulation to much that might not otherwise find a convenient medium of publication in the transactions of the Philosophical Society. But the Society, both as a body and through its individual members, may do much to ensure the permanence and prosperity of the Folk-lore Society. The President then mentioned that the Society has likewise determined on publishing a *catalogue raisonné* of scientific works relating to South Africa. The Section relating to Botany, by Professor MacOwan and Mr. Bolus, is now almost ready for publication. Mr. Trimen has kindly undertaken the department of Zoology; Dr. Hahn of Ethnology; Mr. Schunke of Geography; and Mr. Gamble of Meteorology. It is hoped that this catalogue, when finished, will be of service to future students in these departments of knowledge as relating to South Africa.

The President then mentioned a suggestion that there should be added to the Transactions a few pages of intelligence likely to be of interest to members, such as extracts from newspaper notes and other ephemeral publications, regarding matters of interests to the student, such as notices of intelligence from travellers in the field, &c.

Many of the reports submitted to Government and Parliament are of much scientific interest, and abstracts of them would be extremely valuable additions to the Society's Transactions. For instance, the report of Professor Brandford on subjects connected with cattle; of Mr. Gamble on irrigation; reports on Geological and other surveys; reports in the Native Department like that of Mr. Palgrave; some of the reports on Botanical Gardens; and similar Parliamentary Blue-books. If each reporter were asked by the Secretary to give a short abstract from his paper, as far as it contained matter of scientific interest, and to note the questions which he thinks might be usefully investigated by scientific men, much information of scientific interest might be obtained and recorded. For instance, Professor Brandford might by such means obtain information regarding the propagation or extinction of plants useful

or poisonous for grazing purposes; on the parasites to be found on and in domestic animals; on the appearances in the dissection of diseased animals; on the effect of phosphates and salts of various kinds on animal and vegetable life. Mr. Gamble might obtain, in a similar way, information which he requires regarding rain-fall and water-supply in particular localities, &c., &c.

In conclusion the President remarked:—

"In reply to my inquiry as to causes which have retarded our success, and how greater results might be expected in future, one of the Society mentioned the small amount of public interest taken in our proceedings.

"I own it seemed to me we had been as successful in this respect, as I expected, and perhaps as we deserved; but for the future I would ask each member not only to bring friends to our meetings, but to induce others to aid as permanent members in the Society's labours. It was first supposed that our Society excluded ladies; but this was not the case, and we may in future hope not only to see them frequently as part of an interested and intelligent audience at our meetings, but often themselves able, like Mrs. Barber, to contribute valuable papers to the Society's Transactions. Let us remember that we do not require, exclusively, reports of original discoveries—not even of South African discoveries. All science is imperfect, and no science is confined to any one continent or country.

"Few in this country have access to libraries or even scientific periodicals, and a paper which summarises results of European or American scientific research may throw light on and stimulate research here, even if the name of "Africa" is not mentioned in the paper.

"At every turn we are met by evidence of the want of an accurate survey and maps of the country. If we take the coastline from the Orange River round the Cape to the Bashee River in Kaffraria, the country between the sea and the water-parting of the mountain ranges which form the southern boundary of the Orange River Basin, comprises almost the whole of that portion of this Colony which is accurately triangulated. Natal is partially triangulated. With these exceptions, no large portion of South Africa has been accurately triangulated. In other words, nowhere else is there the foundation of

any accurate map or survey. As instances of defects, let anyone compare the course of the Orange River, or the shapes of Griqualand West, the Orange Free State, or Transvaal, in a map of ten or even five years ago with one of this year, and remember that even the latter is still inaccurate, much being little better than eye-survey and often guess-work. One-third of the course of the Great Orange River between Pella, on the road to Nisbet's Baths in Great Namaqualand, and the junction of the Vaal, is fairly surveyed; one-third I am told has been inaccurately surveyed; and one-third is still unsurveyed, put in on our best maps by guess and eye-survey. A few years ago, Kimberley was in most maps 20 or 30 miles out of its true position, and the continent was by so much to narrow on many maps. Griqualand West has been fairly surveyed by Col. Warren and Mr. Orpen, but in the Transvaal very few positions and no length of the river-courses have been accurately laid down.

"The Society will be glad to hear that the Astronomer-Royal has already turned his attention to this subject, and will, I hope, bring before the Government, here and at home, a plan for a survey on scientific principles, a triangulation as a basis, and then accurate large surveys such as will be useful to geological and all other surveyors.

"A vast amount of useful information is to be expected from all employed on such surveys. To estimate what may be thus expected, we have only to refer to the records of the grand Nigometrical Survey in our own country or in India, and indeed wherever such a work has been attempted.

"Scientific men know how little they can do in any country without the Museum, the Library, the Botanical Gardens, and the Laboratory. Let us hope as regards the three first mentioned that our Government will take in hand the measures necessary to make the existing institutions we now have more adapted to our growing wants. When Parliament is itself properly housed, I hope the Legislature will not grudge the means necessary to fence and develop the Museum, the Grey, the and the Public Libraries, and to add to their treasures. We may also hope ere long to see the noble offer made by Mrs. Jamison form the foundation of such a Laboratory as the capital of the country ought to possess.

"We may hope to receive valuable contributions as well as to stimulate research in other parts of South Africa. I need not tell the Society how much has been done by Dr. Atherstone and others at Graham's Town, or what an excellent beginning has been made by the Library with a Musuem adjoining it at Port Elizabeth. In Natal, also, the Natal and Microscopical Society have long since commenced work, and we may hope that the Transvaal, Orange Free State, and Griqualand West will not long be behindhand in this branch of progress.

"Meanwhile, let us aspire to make this Society the centre which shall draw together into one focus the labours of all lovers of true science, and to which all searchers for truth and sound knowledge in all parts of South Africa may look for aid to prosecute their studies and researches.

"I would congratulate the Society on our having persuaded the Astronomer-Royal to take the office of President, which I am now vacating. Our recollections of what we, beyond even the world at large, owe to his great predecessor, Sir William Herschel, and to those who succeeded him, more especially to the venerated philosopher whom we have so lately laid in his last resting-place, may encourage us to anticipate the best results from Mr. Gill's supervision of our labours. From one devoted to an ever progressive and limitless science like Astronomy, a science which demands the reinvestigation of so many of its truths as fast as any new discovery is made regarding lights or heat, or whenever any improvement is effected by never resting mechanical genius, devoted to perfecting optical and other scientific instruments, a science whose field is as boundless as space, from one devoted to such science we must not hope for more than a portion of his time and attention. But on the principle that the industrious man who has most to do has always most time to devote to other works of utility, and remembering that the true philosopher finds nothing connected with the progress of human knowledge alien to his studies or irksome to his attention, we may hope that the Astronomer-Royal will, during his Presidency, make our Society in some sense worthy of the vast field which lies before it, and of those colonists who hope to make Africa less deserving than it is now of its name as the 'Dark Continent.'"

XVIII. *Note on the "Singerjie" (Platypleura capensis).*—By C. Lloyd Morgan.

[Read 27th August, 1879.]

In the following note, I propose to lay before the South African Philosophical Society a few remarks on the singing apparatus, the mouth organs, and the ovipositor of the "Singerjie," and at the outset I must state that the facts herein mentioned do nothing more than confirm the views of Reaumur, published more than a hundred years ago.

First, with regard to the singing apparatus. Few, I suppose, can have failed to notice in the hotter months of the year the sharp metallic sound produced by the insect under consideration. And few, I suppose, can have failed to stop for a moment to see what sort of insect possessed these tuneful powers. It is soon found that the male cicada alone possesses the power of singing, the female—recognised at once by the ovipositor folded beneath the abdominal somites—being dumb. If, now, the ventral surface of a male singerjie be examined, two large plates are at once observed, one on either side, but meeting in the centre, which plates extend backwards from the hinder thoracic portion over the anterior abdominal somite. On turning the insect over, and looking at the dorsal surface, two very much smaller plates are seen extending forward from either side of the first abdominal somite. Beneath each of these plates (which may easily be removed by the aid of fine-pointed scissors) is seen the somewhat wrinkled surface of a thickish membrane, which may be called the drum. Turning the insect over again, so as to examine more carefully the ventral aspect, and removing one of the large plates, two diaphragms are disclosed, separated by a transverse chitonous support. Of these, the anterior is white, narrow, and opaque, the posterior translucent, round,

and tightly stretched. The second ventral covering plate should now be removed disclosing a second anterior and posterior diaphragms; and the abdominal portion of the insect should be separated from the rest of the body. When this is done there are seen taking their origin from a ventral medial rib two muscular pillars, each of which, proceeding upwards and outwards terminates in a chitonous plate, the upper side of which is in turn connected by a fine ligament with that membrane which has above been called the drum. Under a moderate microscopic power, this drum is seen to be strengthened with brownish ribs, which, together with its own elasticity, cause the drum to spring back after it has been drawn forward by the action of the muscular pillars. This can be experimentally proved by the aid of a pair of fine forceps; and each time the drum is drawn forward and springs back a click is heard. That the well-known metallic sound is produced by a rapid succession of such clicks is put beyond question by the fact, that by irritating with a knife-point the muscular pillars in a freshly-killed insect, the singing noise may be set a-going, which metallic sound will be continued for several seconds *at least* without again touching the muscle. A weak current of electricity also caused the singing to commence. The stretched diaphragms, one of which, running longitudinally along the medial line of the abdomen between the two muscular pillars I have not hitherto mentioned, are probably for intensifying the sound; and I have noticed that rythmical motions of the abdomen of a live insect produce rythmical alterations in the intensity *if not the pitch* of the sound. The covering plates are doubtless mainly for protection; but the fact that on their removal the sound is less full and intense shows that they also play the part of sounding boards.

Secondly, with regard to the mouth organs. The short broad head is prolonged into a somewhat lengthy proboscis, down the anterior portion of which runs a slight grove or depression. Slight constrictions roughly divide this trunk into three portions, the distal portion, bearing small hairs, easily seen under a low power. If this sheath be drawn downwards it is found to enclose three fine styles, covered at the proximal end by a

little plate. Under a high power, the central style is seen to terminate in a simple unnotched blade; but the two lateral styles are toothed on their exterior edges, the teeth facing downwards as in an ordinary hand-saw.

With regard to the homologies of these parts, it would clearly be unsafe to offer any definite opinion without careful study of the embryological development. It will be sufficient here to state that the generally recognised opinion—as I gather from my notes of Prof. Huxley's lectures, and from his "Invertebrata"—sets down the styles as mandibles and maxillæ (of which the former probably have coalesced to form one style), the little plate above being the labrum, while the fleshy trunk is the much-developed labium. On this labium, there seem to me to be clear traces of labial palpi. Under a high power, the central style bears—in some specimens at least—some traces of its compound nature. But in no way could I cause it to split up into two parts, so that the statement that there are four such styles is, I feel sure, incorrect.

On examining the ventral aspect of a female singerjie, one of the posterior somites is seen to be peculiarly developed. It is lengthened out, and bears a longitudinal groove. A little examination discloses the long lance-like and barbed ovipositor lying in this groove, doubled down under the body, with its point forward; and somewhat more careful dissection displays two processes extending backwards, and forming a kind of sheath, in which the ovipositor rests. At first sight, the ovipositor is a simple black lance, the terminal portion widening out like a flat spear-head, and bearing teeth. It is sometimes found, however (as in the specimen mounted and figured), that the "spear head" is asymmetrical, one side having apparently moved down while the other side had been pulled up. And when this is so, a central *symmetrical* untoothed lance head is seen between these asymmetrical toothed portions. The true structure of the ovipositor is thus disclosed. A black spear-shaped style, bearing a well defined ventral groove, lies in a sheath composed of two lateral portions, which lateral portions admit of a longitudinal motion, probably of a sawing nature.

Concerning the development of the ovipositor, opinion seems to be divided. According to Lacuze Duthiers, the median style, the lateral portions (in this case toothed) and the valvular sheath in which the ovipositor rests are all developments of the ninth abdominal somite. According to some recent investigations on the sting (which is but a modified ovipositor) of the hive-bee and the wasp, and the ovipositor of an Ichneumon-fly, however, so far as I understood it from Professor Huxley's description, the lateral toothed portions are the "result of the metamorphosis of papillæ seated on the sternal surface of the eighth somite, and these papillæ are so similar to those from which the limbs are developed that it becomes (to say the least) probable that they represent true appendages of the somites to which they are attached."

There is one more point in the anatomy of this insect to which I wished to have directed especial attention. Anterior to the large covering plate which protects the organs of the singing apparatus, is a much smaller covering plate, similar in form. It is my belief that this protects the auditory apparatus, but I find it impossible to work out the subject on specimens preserved in spirit, and therefore have no carefully observed facts by which in any way to substantiate my belief. This is a point I hope to look into at some future time.

XIX. *Contributions to a Comparative Dictionary of the Bantu Languages.* I.—Collected by C. G. Büttner, Missionary, Director of the Augustinum Institution, Otyimbingue, Damaraland.—Communicated by the General Secretary.

[Read, 27th August, 1879.]

Languages Compared:

1. Afudu.
2. Akurakura.
3. Alege.
4. Babuma.
5. Bagba.
6. Balu.
7. Banron.
8. Basa.
9. Baseke.
10. Basunde.
11. Bayon.
12. Bechuan.
13. Boritsu.
14. Bumbete.
15. Bute.
16. Comoro.
17. C. Delgado.
18. Diwala.
19. Dsharawa.
20. Dshuku.
21. Eafen.
22. Ekamtulufu.
23. Eregba.
24. Gindo.
25. Ham.
26. Herero.
27. Inhambane.
28. Isuwu.
29. Kabenda.
30. Kaffir.
31. Kambali.
32. Kamuku.
33. Kanyika.
34. Kasands.
35. Kiriman.
36. Kisama.
37. Konguan.
38. Koro.
39. Kum.
40. Lor. Marquez.
41. Lubalo.
42. Makonde.
43. Marawi.
44. Matatan.
45. Mbamba.
46. Mbarike.
47. Mbe.
48. Mbofon.
49. Melon.
50. Meto.
51. Mfut.
52. Mimboma.
53. Mombas.
54. Momenya.
55. Mozambique.
56. Mudsau.

57. Murundu.
58. Musentandu.
59. Mutsaya.
60. Ndob.
61. Ngoala.
62. Ngola.
63. Ngoten.
64. Nhalemoe.
65. Nki.
66. Nkele.
67. Nsho.
68. Ntexe.
69. Nyamban.
70. Nyamwezi.
71. Nyombe.
72. Okam.
73. Otyambo.
74. Pangela.
75. Papiah.
76. Paxam.
77. Pati.
78. Penin.
79. Pongwe.
80. Quellimane.
81. Runda.
82. Sena.
83. Shambala.
84. Sofala.
85. Songo.
86. Swahili.
87. Tette.
88. Tiwi.
89. Udom.
90. Xosa.
91. Yao.
92. Yasgua.
93. Zaramo.
94. Zulu.

N.B. Kaffir means Zulu and Xosa. Kiriman=Quelliman, Nyamban=Inhambane.

Dictionaries.

S. W. Koelle. Polyglotta Africana.
Dr. Wm. H. I. Bleek. The Languages of Mozambique.
E. Steere, LL.D. A handbook of the Swahili Language.
" " " Collections for a handbook of the Yao Language.
" " " Collections for a handbook of the Nyamwezi Language.
" " " Short specimens of the Vocabularies of three unpublished African Languages (Gindo, Zaramo and Angazidja).
" " " Collections for a handbook of the Shambala Language.
" " " Collections for a handbook of the Makonde Language.

Roman Catholic Missionaries.	Dictionnaire français-pongoué, Par les Missionnaires de la Congrégation du Saint-Esprit et du Saint-Cœur de Marie.
W. Davis.	A dictionary of the Kafir Language.
Perrin.	English-Zulu Dictionary.
J. Ayliff.	A vocabulary of the Kafir Language.
J. Brown.	Dictionary of the Bechwana Language.
	My own Collections for the Herero and Otyambo languages.

In most cases the spelling of the different writers is retained.

S ([as] in Koelle's and Bleek's books) is written *sh. Ds dsh.*

χ is the deep guttural, met in Kaffir and some other languages.

N in Becwana is like *ng* in the other languages.

C in Becwana „ „ *ch* „ „ „ „ „.

U in Pongwe, *u* (very often) in Herero is like the English *w.*

Gn in Pongwe like *ny* in other languages.

Ou „ „ like the English *oo* in *tool.**

* [In justice to the Rev. Mr. Büttner, it should be stated, that where (in consequence of want of uniformity in his manuscript, and one rather unusual mode of marking used by him) his intentions regarding the kind of type to be employed, &c., were not perfectly clear, the distance from Cape Town at which he lives made it impossible to consult him upon any doubtful points while the printing was going on.

Also, several marked letters, used by Mr. Büttner, to indicate certain sounds, were not to be found here; which necessitated the substitution of other signs for them, as follows:

For the *r* with a dot underneath it, used by Mr. Büttner, χ has been employed.

For the "Spanish *N*" (*i.e.*, an *n* with the mark ~ over it) a dotted *Ṅ* has been used.

For *S* with a dot underneath it, used in two instances by Mr. Büttner in lines two and three of his explanatory remarks, a plain *S* had to be substituted.]

In Kaffir *c*, *q*, *v*, *x*, mean the different clicks.*

1. LUNG. 1. God (in heaven).

In Swahili almost always *Mwenyiezi Muungu* Almighty God. In Herero very often *Tate Karunga* God our father.

Mulungu Yao, Shamb., C. Delg., Gindo.† *Mulungulu* Inhambane (=Mulungu ongulu ?).

Murungu Sofala, Tette. *Murungo* Sena. *Karunga* Herero, Otyambo.

Mulugu Quelliman, Mozambique, Meto, Matatan.

Muungu Suahili.

Aondo Tiwi.

2. *Heaven.*

Kalunga Ngola ? cf. *Orungban* Okam.

Ulanga Zaramo.

Luwingo Shambala, Makonde. *Uwingu* Swahili. *Liwinke* Isuwu.

Ilunde Nyamwezi. *Liunde* Yao. cf. *Wa-muluku* heaven. Kiriman. *Wa-molugu* heaven. Matatan.

3. *Sun.*

Ilanga Kaffir.

4. *Cloud.*

Mawingo C. Delgado.

Mahundi Gindo.

Evindi Pongwe.

* [In making this statement regarding the use of *v* in Kafir, the Rev. Mr. Büttner is in error, as the following extract from p. 233 of the Kafir-English Dictionary by the Rev. W. J. Davis (London, 1872) will show: "*V* is a soft labial, and is sounded in Kaffir like *v* in the English words, vice, vine, &c." The fact that *v* has been used (as, for instance, by the Rev. H. Tindall in his Nama—Hottentot Grammar and Vocabulary, Cape Town, 1857) to indicate the palatal click (≠) met with in Hottentot (found also in the Bushman language) may have led to this mistake. This is another proof, were such needed, of the practical inconvenience of employing Latin characters to indicate the clicks.]

† Here and otherwise words of different languages are taken together, if the form of the word is the same, although the prefixes may differ.

2. NDYAMB. 1. GOD.

Ondyambi Herero. *Ndshambi* Musentandu, Babuma, Bumbete. *Ndshambe* Mbamba. *Ndshami* Nteχe. *Nshambe* Nkele, Undaza.
Mpambe Marawi.
Ndzambi Mimboma, Nyombe, Basunde, Lubalo. *Ntsambi* Ngola. *Nzambi* Kabenda. *Nsambi* Kasandsh, Kisama. *Ndzama* Mutsaya.
Anyambe Baseke, Orungu, Diwala, Isuwu, Pongwe.
Nyama Nhalemoe, Melon, Ngoten.
Ndam Eafen, Konguan.
? *Eshowo* Udom, Mbofon. *Esowo* Ekamtulufu.

2. *Ancestral spirit.*

Inyambe Pongwe.

3. *Heaven.*

Nzambi Nyombe. *Nsambe* Orungu.
Nyama Isuwu, Melon.

No. 1 and 2 together.

Karungandyambi, Ndyambikarunga Herero.
Ntsambi apungo Ngola.
Nyamba liwinke Isuwu.
Nganansampi Songo. *Ganansambi* Kisama.
? *Ukengitsa* Eregba.
? *Nongiu* Bagba.
? ? *Nyikoab* Balu. *Nie kuob* Momenya. *Niekob* Bayon, Kum.
? ? ? ? *Tsui≠goab* *Namaqua. *Utixo* Kaffir.

3. YUL. HEAVEN.

Yulu Babuma, Bumbete, Mbamba, Basunde. *Yilo* Kabenda. cf. *Iuu* Swahili above.
Eyuru Herero.
Izulu Kaffir. *Asulo* Kambali. cf. *Dsulo* C. Delg. above.

* [This word is usually written with the lateral, and not the palatal click.]

Kuzuru Tette. cf. *Uzuru* Quell., Mozamb. above.
Evulu Otyambo.
Kulo Kisama. *Kolu* Nyombe, Undaza. *Gola* Ntexe. *Gore* Sofala. cf. *Igulya* Nyamwezi above.
Legodimo Bechuana.
? *χowa* Nkele. *Rowa* Murunde, Pongwe.

2. *God.*

Asulo Kambali.
? *Kogol* Dsharawa.

4. ? EARTH.

Ehi Herero. cf. *Pehi* Herero beneath.
Esi Otyambo. cf. *Pasi* Yao, Makonde, Sofala, Gindo, Inh. beneath.
Inchi Swahili. *Nzi* Nyamwezi.
Nichi Shambala.
Ntye Pongwe.
Lehatse Bechuana. cf. *Pandzi* Sena, earth. *Pansi* C. Delg., earth. *Panze* Tette, Sena, Marawi, beneath. *Pantsi* Kaffir, beneath. *Vati* Quell., Mozamb. beneath.

5. YUV. 1. SUN.

Eyuva Herero. *Iua* Swahil. *Liwa* Nyamwezi. *Liua* Yao.
Zuva Tette, Sofala, Quell. *Zua* Shamb., Moz.
Dzuwa Sena. *Dzua* Marawi. *Dsua* Anjuan. *Indshus* Afudu. *Intsoa* Kiriman, Meto, Matatan. *Diowa, Loba,* Basete.
Lowa Isuwu. *Lebue* Alege.
Adshui Mbe. *Shui* Nsho.
Ndshudshi Eafen. *Letsatsi* Becwan.

2. *Day.*

Eyuva Herero. *Liua* Yao.
Madua Makonde. *Esui* Alege. *Ese* Nke.
Letsatsi Becwana. *Eyadshe* Okam, ? *Ngoshi* Konguan.

3. *Heaven.*

Dioba, Loba, Baseke.
? *χowa* Nkele. *Rowa* Murunde, Pongwe. cf. No. 3.

4. *Moon.*

Ndzui Nteχe. *Ndshui* Babuma, Mutsaya. *Nyui* Ndob.

6. WEZ. MOON.

Mwezi Swahili, Nyamwezi, Shambala, Otyambo, Sena, Tette, C. Delg., Manika.
Omueze Herero, Anjuan. *Mwesi* Yao. *Muedze* Sena.
Muete Lor. Marq. *Gmuat* Balu.
Kgwedi Becwana. *Mwedi* Makonde.
Mueri Mozamb., Kiriman, Meto. *Muere* Quell., Matatan.
Ohuere Orungu. *Wuele* Tiwi. *Muoli* Penin.
Mbeshi Kasands, Lubalo, Kisama. *Mbeshe* Ngola. *Mbei* Pangela.
Mue Momenya, Bagba, Balu, Afudu. *Mua* Papiah. *Me* Ekamtulufu, Udom, Mbofon.
Muefi Bagba, Kum. *Nyofi* Bayon. *Kofi* Alege. *Fsie* Okam. *Fe* Ham, Akurakura, Yasgua.
Unyezi Kaffir (moonlight).

2. *Star.*

Ikwezi Kaffir (morning star).

7. NYOND. 1. STAR.

Nyota Swahili. *Onyose* Herero. ? *Nyenyezi* Tette, Sena. *Nyenyesi* Gindo, Zaramo. *Nyanyese* Marawi. *Inyelete* L. Marq. *Nyuladi* Inhamb. *Naledi* Becwana.
Ndondwa Yao. *Nondwa* Makonde, C. Delg.
Lutondo Shambala. *Sonda* Otyambo.
Itodva Mozambique.
? *Nyurra* Anjuan.

2. *Moon.*

Ngondshi Undaza. *Ngonde* Musentandu, Mimboma, Diwala, Isuwu, Nyombe, Murundo. *Ngondie* Nkele. *Ngonte* Sonda. *Ngont* Mbamba. *Ngonda* Babenda, Basunde. *Ngondo* Bumbete. *Ngon* Ngoten, Melon. *Ngoan* Nhalemoe. *Ndaa* Baseke. *Nont* Runda, *Ntan* Nkele.

3. *Sun.*

? *Munyenye* Kanyika. cf. No. 8.

8. TANY. 1. Day.

Otanya Pangela. *Omutenya* Herero. *Muluanya* Kisama, Lubalo.
Mutana Quellim., Swahili, Meto, Matatan. *Ntane* Nkele.
Nsana Marawi, C. Delg. *Nuana* Basa. ? *Tenom* Ham.
Oüanda Pongwe.
Mote Ngoten. *Moti* Melon. *Mue* Mbamba. *Motlha* Becwana.
Munyenyi Kanyika. cf. No. 7.

2. *Noon.*

Omutenya Herero. *Nsana* C. Delg. *Miane* Inhamb. *Muhanya* Yao.

3. *Sun.*

Ntangua Mimboma. *Ntangu* Kabenda, Musentandu, Bumbete.
Etango Otyambo. *Muten* Runda, Anan.
Muanya Ngola, Lubalo, Songa. *Iyange* Tiwi.
Urana Kambali.
? *Etondiob* Melon. *Mosondshi* Murundo.
Shundshi Undaza.

9. ? ISHI. 1. Day (Daylight?).

Mushi Becwana, Shambal. *Mohi* Makonde (daylight).

Bumuidsha Kabenda. *Muese* Isuwu, Diwala, Murundo. *Misi* Zaramo.
Muini Mimboma, Musentandu, Nyombe, Basunde.

2. *Noon.*

Muusi Yao.

3. *Evening.*

Omuihi Herero (about sunset). *Misi* Zaramo.

10. GUL. 1. EVENING.

Ligulo Yao, Shambala. *Liulo* Makonde.
Ongulohi Otyambo. *Ongurova* Herero.
Ukuhlwa Kaffir.
Magaribi Swahili. ? *Maatsiboa* Becwana.
Wate va uriba Quellimane.
Mauro Sena. *Siuro-uro* Tette.

2. *Night.*

Kilo Zaramo, Shambala. *Chilo* Yao, Makonde.
Builu Kabenda, Nyombe. *Bulu* Diwala. *Bula* Isuwu.
? *Ohiyu* Mozambique, Meto. *Ohiu* Matatan.

11. SUK. 1. *Night.*

Osuku Herero, Songo, Kaffir. *Osugu* Kisama. *Osogu* Lubalo, Kasandsh. *Osoko* Ngola, Kiriman. *Botshuk* Mutsaya. *Odshug* Yasgua. *Botshuh* Ntexe. *Tidug* Bayon. *Dag* Dsharawa. *Tsoh* Papiah. *Tsu* Ngoala.
Fuku Mimboma. *Fugu* Musentandu. *Bufuk* Kanyika.
Elukul Udom. *Enukon* Mbofon. *Enokon* Ekamtulufu.
Utsutsu Eregba. *Utmon* Tiwi.
Wodshu Runda. *Bodzu* Nki. *Fondshe* Nki.
Usiko Swahili, Inhambane, Tette, C. Delg., Sofala, Marawi. *Bosigo* Becwan.
Tsiko Sena. *Motiu* Alege, Kiriman.

? *Uhiyu* Mozambique, Meto, Matatan. cf. No. 10.

2. *Time of twenty-four hours.*

Usuku Xosa. *Ntgougon* Pongwe.
Usiku Swahili. *Shiho* Nyamwezi.

3. *Day.*

Tsiku Inhambane, Sena. *Ziko* Tette. *Liko* C. Delg. *Nihigo* Mozambique.

12. TYA. DAWN. (Sunrise?)

Okutya Herero. *Kusha* Otyambo. *Kucha* Suahili. *Cwa* Becwana. *Cha* Makonde. *Ndiyu* Nyamwezi.
Ukusa Kaffir. *Utsa* Mozambique. *Mosho* Becwan (morning).
Utsaka Mozambique. *Tioka* Yao. *Kusoka* Tette. *Omuhuka* Herero (morning).
cf. *Okutoka* Herero (Sunset).
Kudoka Tette (Sunset).
Chwa Swahili (Sunset).

13. LIL. 1. FIRE.

Umlilo Otyambo, Kaffir. *Molelo* Becwana. cf. *Nlila* Basa (coals).
Omuriro Herero, Sofala, Mwiza. *Morro* Anjuane, Mozamb., Meto, Matatan.
Ndolo L. Marq. *Ndelo* Nyamban. *Munillo* Inhambane.
Muoto Shambala. *Moto* Yao, Nyamwezi, Swahili, Makonde, Tette, Sena, C.Delg., Marawi, Kiriman, Mudsau.
? *Mo* Paχam, Angola. *Mu* Nhalemoe, Melon, Ngoten, Papiah, Momenya, Bamon, Balu, Bagba, Kum, Bayon.

2. *Sun*

Moto Penin. *Mot* Mfut. *Mmo* Konguan.
? *Mes* Dsharawa.

3. *Moon.*

Mot Bamon. *Woto* Kambali.

4. *Day.*

? *Mot* Mfut.

cf. *Uota* Herero. *Ota* Kaffir, to warm one's self at the fire.

14. PIY. HEAT, HOT.

Heat. *Oupyu* Herero.

Hot. *Mainse ovia* Quell., *Madsi ku pisa* Sofala (warm water). *-sewu* Nyamwezi, *Shushu* Xosa (hot).

Cook. *Pika* Swahili, Sena, Tette. *Piga* Marawi. *Mbzeka* L. Marq. *Ipika* C. Delg. *Wapea* Mozamb. *Villa* Inhamb.

Burn. *Piya* Inhambane. *Pia* Herero. *Pisa* Sena. *Peya* Pongwe. *Uvia* Mozambique. *Pila* Yao (be consumed by fire).

Boil, Sweat. *Bila* Kaffir.

Ripen. *Pya* Nyamwezi. *Iva* Swahili, Makonde.

Fire. *Tubia* Lubalo, Songo. *Tiwia* Mimboma, Musentandu, Kisama. *Mba* Mbamba, Nteχe, Mutsaya, Babuma, Bumbete.

Cooking pot. *Ombiga* Otyambo. *Dsiwiga* Yao. *Imbiza* Kaffir. *Bise* Eafen. *Pitsa* Becwana.

Mbia Ngola, Pangela, Lubalo, Songo, Kisama, Marawi, Quell.

Mbe Nhalemoe, Dshuku, Ngoten, Melon.

? *Nshe* Mbofon, Udom, Nse, Ekamtulufu.

Coal. *Akapiu* Dshuku. *Kebiri* Nteχe. *Gebilu* Babuma. *Kebit* Mutsaya.

cf. *Mugima mupia* Inhamb.
Muezi mupia C. Delg.
So pie Dshuku.
Me memfe Ekamtulufu, Udom, Mbofon.
Mbesi obe Lubalo. *Ngonte owe* Songo.
Ngonte ampa Musentandu.
Minofe Paχam.
Nyofi Bayon. *Nuefi* Kum.
Muefi Bagba.
Gmamfi Balu.
} New moon.

15. NDIND. SMOKE.

Ndindi Bagba, Momenya.
Ndzindshe Bamon. *Ndintsi* Pati. *Ntsontsua* Papiah. *Ndshon* Ham, Akurakura. *Odshu* Yasgua. *Dsum* Bute. *Nto* Koro.
Ndshisi Balo. *Wudshi* Kiriman.
Muishi Basunde, Songo, Kisama. *Moshi* Shambala, Swahili. *Lioshi* Nyamwezi. *Liosi* Yao. *Rosi* C. Delg. *Mosi* Becwana, Gindo. *Umusi* Kaffir.
Muizi Nyombe, Kabenda. *Muiz* Musentandu.
Owisi Pangela, Meto. *Moesi* Matatan. *Oluisi* Otyambo. *Omuise* Herero. *Muse* L. Marquez. *Wutse* Marawi. *Utsi* Inhamb., Sena. *Udsi* Quelliman. *Usi* Tette. *Widi* Baseke.
Mututo Murundo. *Mututu* Isuwu, Diwala, Orungu.
Metut Melon. *Metud* Ngoten.
? *Moatu* Nhalemoe.

16. DEB. 1. WATER.

Madeba Diwala. *Madiba* Nkele. *Madib* Ngoten, Melon.
Dshape Basuku. *Ndshab* Kum, Bagba. *Ndshib* Bayon. *Ndshob* Momenya.
Medi Makonde. *Mati* L. Marq., Inhamb., Nyambane. *Madshi* C. Delg., Sofala, Papiah. *Mazi* Shambala, Gindo, Zaramo, Mozambique. *Masi* Meto, Okam, Yao. *Mese* Mudsau, Anjuan. *Madsha* Nteχe, Mutsaya, Babuma. *Mandsha* Bumbete, Mbamba. *Mandshe* Kiriman. *Maza* Mimboma, Musentandu. *Mandse* Quellimane. *Madze* Tette. *Amanzi* Kaffir.
Maliwa Isuwu, Murundo. *Alap* Ekamtulufu, Udom.
Manif Penin. *Manep* Konguan.
Omeva Herero. *Omea* Otyambo. *Ame* Yasgua. *Omo* Nki. *Amu* Alege.

Menya Songo, Kisama, Ngola. *Menyi* Runda. *Meni* Basa, Kamuku, Kambili. *Meya* Kasandsh.
Mangu Undaza. *Man* Akurakura.

2. *River.*

Tsimazi Tette. *Muinzi* Quellimane.

3. *Rain.*

Alap Udom.
Aneb Mbofon. *Manep* Konguan. *Menif* Penin.
Owashi Akurakura. *Asi* Okam, Bute.

4. *Milk.*

Madeba Diwala. *Masuba* Akurakura. *Medimba* Ngoten.
Maziwa Swahili, Marawi. *Masiwe* C. Delgado.
Omaihi Herero. *Ubisi* Kaffir. *Imbise* Lor. Marq. *Mashi* Becwana. *Amasi* Xosa.
Amoabi Alege. *Eba* Anan. *Ebi* Akurakura, Nhalemoe. *Ebe* Melon.
Amenu Orungu. *Vumina* Basunde.

17. MBUL. RAIN.

Mbula Nyamwezi, Bumbete, Undaza. *Mbola* Mbamba.
Ombura Herero. *Ombera* Pangela. *Mbuχa* Nkele.
Mbua Isuwu, Diwala, Murundu. *Mbue* Balu. *Mbuyo* Baseke. *Mbo* Ngoten.
N'bun Ngoala. *Mbon* Kum, Bagba, Paχam. *Mban* Bayon, Bamon. *Mben* Momenya, Papiah.
Pula Becwana, Meto, Mozambique.
Fula Shambala, Kabenda, Mimboma, Musentandu, Nteχe, Babuma, Nyombe, Basunde, Lubalo, Kisama, L. Marquez. *Mpfol* Mutsaya. *Umfal* Runda.
Ofol Kanyika, Dsharawa.
Mvula Kaffir, Otyambo, Inhambane, C. Delg. *Vura* Tette, Marawi, Sofala.

Mwua Swahili. *Ula* Yao.
Ashila Basa. *Ashile* Kamuku.

18. ? LIGHTNING.

Orutyeno Herero. *Peni* Tette (flash of lightning). *Umbane* Kaffir.
? *Pieti* Sena (flash of lightning).
Umeme Swahili. *Umwemwe* Shambala.
Dsaze Sena. *Tshaze* Tette.
Logadima Becwana.

19. TUTUM. THUNDER.

Orututumo Herero. *Kwantutumo* Shambala. *Okundunduma* Otyambo. *Tumo* Becwana. *Kudidimo* C. Delgado. *Vumi* Sofala.
Chikukumo Yao. *Nkuwa* Nyamwezi. *Zongome* Xosa.
Magurrugurru Tette.

20. LAMB. RIVER.

Umlambo Kaffir. *Murambo* Sofala. *muramba* Herero.
Molapo Becwana.
Nambo L. Marquez.

21. MBUND. 1. MIST, FOG.

Ombundu Herero. *Lipundugulu* Yao.
Zunde Shambala.
Inkungu Kaffir, Swahili. *Inkongugu* Nyamwezi. *Kungusi* Tette.

2. *Dew.*

Mbundu Ngola, Songo, Kisama. *Mbundo* Kasandsh. *Mbonda* Pangela. *Mbundshi* Kabenda. *Bungi* Basunde.
Nkungo Marawi. *Nkuta* Nkele.

22. NGAM. DEW.

Mangame Yao. *Okame* Meto, Matatan. *Kima* Musentandu.

Omueme Herero. *Omume* Otyambo. *Omomi* Kanyika. *Moma* Kum. *Mema* Papiah. *Mame* Sena. *Mam* Tumu. *Mmi* Bute. *Mumiah* Inhambane. *Umio* Quellimane.
Limume Lubalo. *Lumo* Nyamwezi.
Umande Swahili.
Nambwe C. Delg. *Dshime* Basa.
Monyenye Nteχe. *Monyayo* Mutsaya. *Munogo* Babuma. *Monyo* Becwana.

23. MBEP. 1. WIND (Air, cold).

Ombepo Herero, Yao. *Upepo* Swahili, Sofala. *Pepu* Tette, Sena. cf. *Chipepeta* Makonde, *Epepe* Pongwe (fan).
Pubo Inhambane.
Pevo Quellimane. *Ipeo* Mozambique.
Mbeho Nyamwezi. *Peho* Shambala. *Pheho* Becwana. cf. *Mbebe za mbua* Gr. Comoro (nostrils).
Dimepo Makonde. *Mepo* C. Delgado.

2. *Breath, Soul.*

Umpefu Xosa (an asthmatic breathing).
Umpefumlo Kaffir (breath, soul). cf. *Ibupu* Nyamwezi. *Pafu* Swahili. *Lechwaho* Becwana (lungs).

3. *Spirit.*

Mpepo Shambala. *Pepo* Swahili (evil spirit).
Ibambo Pongwe (Revenant).
Ibambo Orungu (Devil). cf. *Kalempemba* Kasandsh. *Kadiampemba* Musentandu. *Kaleampemba* Mimboma, Basunde.

24. ? STONE.

Kiwendi Inhambane.
Jiwe Swahili, Shambala, Nyamwezi. *Ewe* Pangela. *Eoe* Herero. cf. *Ishishiwe* Nyamwezi (pebble).
Lencwe Becwana.
Itye Zulu. *Ntae* Konguan,

Ilitye Xosa. *Salawi* Yao.
Libwe Quellimane (Grindstone). *Mbwe* Swahili (very small stone). *Mbua* Sofala.
Imanya Kabenda. *Maya* Nteχe, Mutsaya.

25. LWAL. CLIFF, ROCK.

Ulwalwa Xosa. *Lwala* Yao. *Muala* Marawi. *Moale* Kiriman. *Muarra* Tette (stone), Sena. *Muara* Quellimane.
Leshala Becwan (white rock). *Idwala* Zulu (a flat rock).
Oruua Herero. *Oluua* Otyambo. *Owua* Bamon. *Woa* Balu.
? *Mwamba* Swahili. *Gamba* Shambala.
? *Maganga* Gindo. *Legaga* Becwana. *Lianga* Makonde. cf. *Nyanganyanga* Makonde (pebbles).

26. TENG. METAL.

1. *Iron.*

Sengo Nyombe. *Zengo* Basunde. *Zengua* Mimboma. *Emianga* Orungu. *Onwanga* Pongwe.
Otyitenda Herero. *Ltene* Ekamtulufu. *Tena* Bamon. *Ten* Bayon. *Tin* Bagba, Momenya. *Ishen* Eafen.
Lidini Nyamwezi. *Chisiano* Yao.
Kitadi Ngola. *Kitali* Babuma, Nteχe, Kasandsh. *Mbitalu* Bumbete. *Otale* Pangela. *Utare* Quellimane, Sena, Tette, Sofala.
Bitampa Songo. *Tsambo* Marawi. *Tsipi* Becwana. *Insimbi* Kaffir. *Msomo* Shambala.
Chuma Swahili, Mozambique, C. Delgado. *Yuma* Meto, Matatan. *Numbo* Lor. Marquez.

2. *Gold.*

Desanga Ngola. *Semban* Kum.
Tena Bamon.
Mpumbo Basunde.

3. *Lead.*

Chumbu Makonde.

4. *Stone.*

Ndono Kum. *Ndon* Bayon.
Tadi Mimboma, Musentandu, Nyombe, Basunde, Ngola, Songo, Kisama.
Litali Kasandsh. *Litari* Lubalo, Baseke.
? *Diyali* Runda.

27. SANG. SAND.

Msanga Yao, Sofala, Quellimane, Makonde. *Mshanga* Shambala. *Mchanga* Swahili. *Mutsanya* Anjuane. *Mtanga* Mombas.
Nyanga Murundo. *Nkienga* Marawi. *Munyengo* Bumbete. *Nienge* Basunde, Mimboma. *Nienke* Nyombe.
Ketsanse Mfut. *Etsen* Nki. *Nse* Melon, Undaza. *Nshi* Nhalemoe.
Omaheke Herero. *Eseke* Pangela. *Ohiaga* Kamuku. *Kisehele* Ngola, Songo, Kisama, Kasands. *Disiele* Mbamba.
Nshishe Mbofun. *Nchie* Babuma. *Dishei* Baseke, Nkele, Undaza. *Kiseyi* Nteχe. *Kisieyi* Mutsaya. *Moshe* Penin.
Sanwa Balu. *Soanma* Bamon.
Moshawa Becwana. *Enchip* Yasgua. *E sep* Konguan.
Isihlabati Kaffir.

28. NOK. CLAY (Mud, Dirt).

Omunoko Herero. cf. *Ubunuku* Zulu (dirty habits).
Ulongo Shambala, Nyamwezi. *Maraga* Inhambane, Becwana.
Udongo Swahili. *Toka* Becwana.
Entsaka L. Marquez.
Mataka Quellimane. *Tagata* Shambala.
Matadza Tette, Sena.

29. TOP. Mud (Clay).

Matope Yao, Makonde, Sena, Gindo, Mozambique, Sofala, Tette.
Ondova Herero. *Uchavu* Swahili.
Omurova Herero. *Marove* Quellimane.
Are No. 27, 28, 29 to be derived from the same root? CHAV?

30. ONGW. Salt.

Omongua Herero, Kasandsh, Nyombe, Basunde, Pangela, Lubalo, Songo, Kisama, Bumbete, Babuma, Mutsaya, Ntexe, Mbambi, Musentandu. *Nkua* Melon. *Nkoa* Ngoten, Nhalemoe, Afudu, Murundo, Ngola. *Ngua* Bamon. *Nguan* Bayon, Paxam. *Ngoan* Kum. *Ngan* Konguan. *Akan* Mbofon, Eafen, Ekamtulufu, Udom. *Ngban* Pati, Bagba, Momenya.
Munyo Lor. Marquez, C. Delgado, Inhambane, Gindo. *Munyu* Shambala, Makonde, Swahili, Sofala. *Munu* Nyamwezi. *Umunyuza* Kaffir. *Muinyo* Tette, Sena.
Eyanga Pongwe, Isuwu. *Vanga* Diwala. *Ezanga* Urungu.
Maka Meto, Matatan.
? *Lecwai* Becwana. *Ledze* Undaza.

31. ? Mountain.

Kigongo Zaramo. *Gigonio* Inhambane. *Lichenje* Yao.
Umango Zulu, Xosa (an elevated tract of land). *Muango* Quellimane, C. Delgado.
Ondundu Herero. *Tunto* Sofala.

32. ZUL. Shadow.

Kizuli Shambala. *Omuzire* Herero. *Kinzimizimi* Nyamwezi. cf. *Sira* Becwana (to shade).

Kivuli Swahili. *Mvuli* Shambala. *Muvuri* Tette. *Mwilili* Yao.
Mpiri Pongwe.
Mururi Mozambique. *Mouiri* C. Delgado.
Muruti Becwana.
? *Mutsa* Inhambane.
? *Itunzi* Kaffir.

33. ? FROTH, FOAM, SCUM.

Povu Swahili, Shambala. *Igwebu* Kaffir. *Leshulo* Becwana. *Lihulu* Makonde. *Liulo* Yao.
Esuzu Herero. *Etutu* Otyambo.

34. WIN. HOLE.

Omuina Herero. *Mwina* Makonde (pitfall, ditch). *Lina* Nyamwezi.

35. VUMB. DUST.

Luvumbi Swahili, Shambala. *Oruuma* Herero. *Luwuwu* Nyamwezi. *Luundu* Yao.
Utuli Kaffir. *Lorole* Becwana.
? *Liuuhi* Makonde. *Ondsi* Otyambo.

36. ? SPACE (Time).

Oruveze Herero. *Nafasi* Swahili.

37. TEL. TREE.

Mtela Yao, Gindo. *Ntela* Makonde (Medicine). *Letlhare* Becwana. *Atiχ* Bagba, Kum, Bayon, Ngoala, Momenya, Papiah.
Mueli Undaza. *Mwiri* Quell. *Nyiere* Nkele. *Erere* Pongwe. *Mbuele* Ngoten, Melon. *Mboal* Nhalemoe. *Puala* Penin. *Bole* Murundo.
Ntanda Nyambane. *Odanga* Kambali. *Mutont* Runda.
Omuti Herero, Nyamwezi, Swahili, Otyambo, Shambala, Kaffir, Sofala, Tette, Sena, Eafen, Eregba, Kabenda, Mimboma, Musentandu, Nteχe, Mutsaya, C.

Delgado, Nyombe, Basunde, Pangela, Yasgua, Mfut. *Eto* Anan.
Ete Ekamtulufu, Udom, Mbofon, Mbamba, Babuma, Bumbete.
Itsi Okam, Nki. *Yetse* Baseke.
Modshi Kasandsh, Kisama, Koro, Nsho. *Modsh* Kanyika, Ngola. *Moshi* Songo. *Munshi* Lubalo. *Osi* Alege.

38. TAMB. 1. BRANCH.

Itambi. Nyamwezi, C. Delgado. *Liyambi* Yao.
Orutavi Herero. *Tave* Sofala. *Tawi* Swahili, Makonde.
Sanwo Tette.
Isebe Xosa.
Tsansu Sena.

2. *Leaf.*

Ambe Basa.
Owavi Pongwe. *Lufovo* Shambala.
Dsafo Momenya. *Idsawe* Orungu. *Yafo* Bamon.
? *Ifan* Anan. *Dshan* Ham.
? *Afu* Papiah, Paχam, Bagba, Mbe, Nsho.

39. KUN. FIREWOOD.

Kuni Swahili, Otyambo, Shambala, Makonde, Kaffir, Quellimane, Mimboma, Basunde, Meto, Matatan, Mosambique, Marawi.
Orukune Herero. *Kunyi* Nyombe, Runda. *Ekun* Udom. *Ngun* Dsharawa. *Nkum* Eafen.
Ekoni Orungu. *Nkon* Mbofon, Mbute, Nki. *Nken* Bayon.
Ekuan Afudu. *Nkuɳ* Kum. *Nkoan* Paχam.
Nkui Babuma, Mutsaya, Undaza. *Lungwi* Yao. *Ekue* Alege, Papiah. *Nkoe* Bumbete, Mbamba, Ngoala.
Ogoni Pongwe. *Logono* Becwana (piece of wood). *Ngodi* Zaramo.
Lohunyi Ngola. *Huinyi* Songo. *Hueni* Penin.
Lohonyo Kasandsh, Lubalo, Kisama.

40. KAL. COAL.

Makala Yao, Songo, Meto, Matatan, Dsharawa, Lor. Marquez, Inhambane, Kasandsh, Nyombe, Basunde, Ngola, Pangela, Lubalo, Runda, Mozambique, C. Delgado, Marawi, Kabenda, Mimboma, Musentandu, Mbamba, Kanyika, Bumbete, Otyambo. *Magala* Becwana.
Ekara Herero, Sena, Quellimane, Kisama.
Ekalaga Undaza.
Makaa Swahili, Shambala. *Aka* Yasgua.
Diaχa Nkele.
Nkan Anan.

41. HUL. THICKET (Forest).

Muhulo Zaramo. *Chihole* Makonde. *Ihlahla* Xosa (a shrub). *Isihlahla* Zulu (a clump of trees).
Ehua Herero. *Lihwa* Nyamwezi. *Lekgwa* Becwana. *Eχo* Otyambo.
Azo Koro. *Udshe* Yasgua. *Iga* Pongwe.
Mutso Lor. Marquez.

42. KWIB. THORN.

Omakuiya Herero. *Omakoeya* Otyambo. *Igwa* Nyamwezi.
Mwiba Swahili.
Ameva Kaffir.
Mwiwa Yao, Shambala, Makonde.

43. NYAS. 1. GRASS.

Linyasi Yao, Swahili. *Malasi* Mozambique (straw).
Ehozu Herero. *Muizi* Otyambo. *Wahi* Makonde.
Uzua Tette. *Udzu* Sena.
Utyani Xosa. *Miani* C. Delg. *Boyan* Becwana. *Mani* Quellimane.
? *Muasiana* Inhambane.

2. *Leaf.*

Manyasi Gindo. *Ndshe* Eafen. *Dshu* Bute.

Diyish Runda.
Nyan Udom, Mbofon.
? *Bosien* Nki.

3. *Flower.*

Sesheshe Becwana.

44. TANG. GOURD.

Etanga Herero, Zaramo.
Tango Swahili, Shambala (melon). *Litangwa* Yao.

45. YONOL. MILLIPEDE.

Liyongolo Yao. *Igongolo* Nyamwezi. *Nyongolo* Shambala. *Chongolo* Makonde. *Jongoo* Swahili. *Kongono* Pongwe.
Tshongololo Zulu. *Engororo* Herero.
Ongongololo Otyambo.

46. GUP. TICK.

Ongupa Herero, Otyambo, Makonde. *Upa* C. Delgado.
Likupe Yao. *Kupe* Swahili.
Fikundya Nyamwezi.
? *Umkaza, Umkalane* Kaffir.

47. ? SPIDER.

Bulibuli Shambala. *Buibui* Swahili. *Liuuwi* Nyamwezi.
Likaikai Makonde. *Lekokgo* Becwana. ?*Isigquawu* Zulu.
Randague Quellimane.
Tandaode Marawi.

48. KONG. SCORPION.

Tsikungo Lor. Marquez. *Kongo* Scha.
Siongo Inhambane.
Ngengu Mutsaya. *Ngena* Bamba. *Ngienu* Bumbete. *Ngian* Dsharawa. *Ngie* Babuma, Ntexe. *Ngeo* Baseke. *Nkue*

Bagba. *Nge* Swahili. *Nga* Konguan. *Nke* Afudu.
Ondye Herero.
Inyakarisi Tette, Sena. *Ogashi* Kambala.
Kalise Yao. *Woalise* Marawi.
? *Kisusa* Shambala.
Phephen Becwana. *Eyipue* Meto.
? *Kamina* Nyamwezi. *Minya* Bute.

49. TWAL. LOUSE.

Intwala Kaffir. *Talawa* Quellimane. *Tsarawa* Sena. *Zavawa* Tette. *Tinwala* Lor. Marquez.
Tawa, Chawa Swahili. *Sawa* C. Delgado.
Nta Becwana. *Nda* Nyamwezi.
Ona Herero.

50. CHWA. WHITE ANT.

Mchwa Swahili, Shambala. *Ohua* Herero. *Oχua* Otyambo.
Uswa C. Delgado, Nyamwezi. *Muo* Inhambane.
Umuhlwa Kaffir.
Mutshenye Tette. *Utshentshe* Sena. *Wetshe* Quellimane. *Ucheche* Makonde.

REGISTERS.

A. *English.*

Ancestral spirit ...	2	Cook	14
Ants, white... ...	50	Dawn	12
Beneath	4	Day ...	5, 8, 9, 11, 13
Boil	14	Devil	23
Branch	38	Dew ...	21, 22
Breath	23	Dirt... ...	28, 29
Burn	14	Ditch	34
Clay... ...	28, 29	Dust	35
Cliff...	25	Earth	4
Cloud	1	Evening ...	...9, 10
Coal...	40	Fan	23

Fire ...	13, 14	Pebble ...	24, 25
Firewood ...	... 39	Pitfall ...	... 34
Foam ...	... 33	Pot	... 14
Fog	... 21	Rain ...	16, 17
Forest ...	... 41	Ripen ...	... 14
Froth ...	... 33	River ...	16, 20
God ...	1, 2, 3	Rock ...	... 25
Gold ...	... 26	Salt	... 30
Gourd ...	... 44	Sand ...	... 27
Grass ...	... 43	Scum ...	... 33
Grindstone ...	... 24	Shade ...	... 32
Heat ...	... 14	Shadow ...	... 32
Heaven ...	1, 2, 3, 5, 8	Smoke ...	... 15
Hill	... 31	Soul ...	... 23
Hole ...	... 34	Scorpion ...	... 48
Hot	... 14	Space ...	... 36
Iron ...	... 26	Spider ...	... 47
Lead ...	... 26	Spirit ...	... 2, 23
Leaf	38, 43	Star ...	... 5, 6
Lightning ...	... 18	Stone ...	24, 26
Louse ..	... 49	Straw ...	... 43
Lungs ...	... 23	Sun	5, 7, 8, 13
Medicine ...	... 37	Sunrise ...	... 12
Melon ...	... 44	Sunset ...	... 12
Milk ...	... 16	Sweat ...	... 14
Millipede ...	... 45	Thicket ...	... 41
Mist	... 21	Thorn ...	... 42
Moon ...	5, 6, 13	Thunder ...	... 19
Mountain ...	... 31	Tick ...	... 46
Mud	28, 29	Tree ...	... 37
New Moon ...	... 14	Water ...	... 16
Night ...	10, 11	Wind ...	... 23
Noon ...	... 8, 9	Wood ...	... 39

B. *Swahili*.

Buibui ...	... 47	Jua	... 5
Chuma ...	... 26	Juu	... 3
Chwa ...	... 12	Iva	... 14
Chawa ...	... 49	Kivuli ...	... 32
Jiwe ...	... 24	Kucha ...	... 12
Inchi ...	... 4	Kungu ...	... 21
Jongoo ...	... 45	Kuni ...	... 39

Kupe	...	46	Mwua	...	17
Luvumbi	...	35	Nafasi	...	36
Magaribi	...	10	Nge	...	48
Maji	...	16	Nyasi	...	43
Makaa	...	40	Nyota	...	7
Maziwa	...	16	Pafu	...	23
Mbeve	...	24	Pika	...	14
Mchanga	...	27	Povu	...	33
Mchwa	...	50	Tango	...	44
Moshi	...	15	Tawa	...	49
Moto	...	13	Tawi	...	38
Mtana	...	8	Uchavu	...	28
Mtanga	...	27	Udongo	...	28
Mti ...	...	37	Umande	...	22
Muungu	...	1	Umeme	...	18
Munyo	...	30	Upepo	...	23
Mwezi	...	6	Usiku	...	11
Mwiba	...	42			

C. *Becwana.*

Amanzi	...	16	Logadima	...	18
Bitsa	...	14	Maatsiboa	...	10
Boraga	...	28	Magala	...	40
Bosigo	...	11	Molapo	...	20
Boyan	...	43	Molelo	...	13
Cwa	...	12	Monyo	...	22
Kgwedi	...	6	Moshawa	...	27
Lechwaho	...	23	Mosi	...	22
Lecwai	...	30	Motlha	...	8
Legaga	...	25	Mpfeho	...	23
Legodimo	...	3	Muruti	...	32
Legokgo	...	47	Mushi	...	9
Legono	...	39	Naledi	...	7
Lehatsi	...	4	Nta ...	...	49
Lekgwa	...	41	Phephen	...	48
Lencwe	...	24	Pula	...	17
Lorole	...	35	Sesheshe	...	43
Leshulo	...	33	Toka	...	29
Letlhare	...	37	Tsipi	...	26
Letsatsi	...	5	Tumo	...	19

D. *Kaffir.*

Ameva	...	42	Shushu	...	14
Bila...	...	14	Tshongololo	...	45
Idwala	...	25	Ubusuku	...	11
Igwebu	...	33	Ukuhlwa	...	10
Ihlahla	...	41	Ukusa	...	12
Ikwezi	...	6	Ulwala	...	25
Ilange	...	8	Umango	...	31
Ilitye	...	24	Umbane	...	18
Imbiza	...	14	Umlambo	...	20
Imini	...	9	Umlilo	...	13
Inkungo	...	21	Umkalane	...	46
Insimbi	...	26	Umkaza	...	46
Intwala	...	49	Umpefu	...	23
Isebe	...	38	Umpefumlo	...	23
Isigqawu	...	47	Umti	...	37
Isihlabati	...	27	Umuhlwa	...	50
Isihlahla	...	41	Umunguza	...	30
Itunzi	...	32	Umusi	...	15
Itye...	...	24	Unyezi	...	6
Izulu	...	3	Usuku	...	11
Lukuni	...	39	Utuli	...	35
Mashi	...	16	Utyani	...	43
Metse	...	16	Zongoma	...	19
Mvula	...	17			

E. *Herero.*

Ehi ...	...	4	Okutoka	...	12
Ehozu	...	43	Okutya	...	12
Ehua	...	41	Omaheke	...	27
Ekara	...	40	Omaihi	...	16
Ekuiya	...	42	Ombepo	...	21
Engororo	...	45	Ombundu	...	23
Eoe ...	...	24	Ombura	...	17
Esuzu	...	33	Omeva	...	16
Etanga	...	44	Omongua	...	30
Eyuru	...	3	Omueme	...	22
Eyuva	...	5	Omueze	...	6
Karunga	...	1	Omuihi	...	9
Ohua	...	50	Omuina	...	34

Omuise 15
Omunoko 28
Omuramba 20
Omuriro 13
Omutenya 8
Omuti 37
Omuzire 32
Ona 49
Ondova 29
Ondundu 31
Ondyambi 2
Ondye 48
Ongupa 46
Ongurova 10
Onyose 7
Orukune 39
Orutavi 38
Orutututumo 19
Orutyeno 18
Oruuma 35
Oruuua 25
Oruveze 16
Otyitenda 26
Otyityauvi 47
Pia 14

XX. *Locusts and Locust Birds.*—By M. E. Barber.

[Read 27th August and 30th September, 1879.]

For ages past the continent of Africa has, we have every reason to believe, been more or less subjected to the plague of locusts, even in the far distant past B.C. 1491—years, when the Pharaohs were reigning in the land of Egypt, the locusts were there. They were then "filling up all the coasts."

The ancient description in the Book of Genesis is most truthful, and in every respect applicable to this scourge as it exists even up to the present time. We cannot, however, at the southern end of the African continent, attribute the visitations of these grasshoppers to the "east wind." Our east wind must, at any rate, be held blameless. If prevailing winds have anything to do with bringing the locusts down upon us, it would be those which reach us from the north; but I question whether winds, to any great extent, influence the general movements of these migratory insects.

Long prevailing droughts (if such there be) in the interior of the continent may, perhaps, have something to do with their migrations, inducing them to visit the sea-board regions in search of food. This, however, is mere conjecture on my part.

It is difficult to discover what are the laws of nature which rule the migrations of vast bodies of living creatures, who, like the locusts, have apparently no means of communication with each other. For instance, who can tell why, at certain seasons of the year, a migration will suddenly take place amongst the white butterflies (*Pieridæ*) when they may be observed in immense flights, spreading over wide tracts of country, and flying at a considerable elevation. In their passage, they scarcely

tarry to imbibe the nectar of their favourite flowers; some hidden impulse ever seems to urge them on. When the night overtakes them, then they roost as best they can. I have seen as many as thirteen individuals concealed beneath the foliage of a species of *Senecio*, a shrub with pale or white undersides to its leaves.

It may be with the locusts as it is with regard to the North American bisons of the Great Prairie, so graphically described in Major Butler's book, "The Wild North Land," from which I extract the following passage.

"Backwards and forwards over the grassy ocean, now north, now south, now filling the dark gorges of the Rocky Mountains, now trailing into the valleys of Rio-del-Note, now pouring down the wooded slopes of the Saskatchewan, surged millions on millions of dusky bisons. What led them in their strange migrations no man could tell, but all at once a mighty impulse seemed to seize the myriad hordes, and they moved over the broad realm which gave them birth as the waves of the ocean roll before the storm, nothing stopped them in their march, great rivers stretched before them with steep overhanging banks and beds, treacherous with quicksand and shifting bar, the work of subterraneous forces crossed their line of march, but still the countless thousands moved on. Through day and night the earth trembled with their tramp, and the air was filled with the deep bellowing of their unnumbered throats. Crowds of wolves, and flocks of vultures dogged and hovered along their way, &c., &c." Even so it is with the locust hordes of South Africa, in their migrations they resemble the bisons, nothing will stay them on their march, they will surmount all difficulties, attempting even the waves of the broad Indian Ocean.

There is, however, no certainty in the migrations of locusts; their visitations are by no means fixed or periodical, many years may intervene between them; or, on the contrary, they may be continuous, obtaining for several years in succession. Like the bisons, the locusts have their hereditary enemies, which continually follow them, and, moreover, they are in a

great measure ruled by them. I allude more especially to the various species of locust birds, who follow on their trail, as the wolves and vultures do on that of the bisons of the Great Prairie.

From long observation, I am convinced that these vast tribes of birds and insects predominate alternately, first the locusts and then the locust birds, and that they are ever keeping each other in check, ever regulating the balance of their power.

The locust birds depend almost entirely upon the locusts for sustenance, their numbers are too vast to be supplied by any other means, and in the end, great though the locust swarms may be, they at length prove insufficient for the maintenance of the multitude, for the birds increase and multiply to such an extent while food is plentiful, that in the course of time the locusts are comparatively speaking consumed, their numbers being greatly diminished. They are however, never entirely exterminated. Small flights from time to time make their escape, getting beyond the ravages of the birds, who are eventually left almost without the means of subsistence, and it is then that "hard times" come down upon the unfortunate feathered tribes; hitherto they have been fed and pampered in the lap of plenty, but now it is their turn to suffer and to die! not as died the locusts by sudden death, but to be scattered far and wide over the face of the earth, and to perish miserably in various ways, through want and famine. Like the locusts, however, they do not all perish. Many survive the catastrophe by picking up a precarious existence here and there, and by eventually finding their way back into the interior, when haply they may meet with other locust swarms.

Such are the vicissitudes which attend the locusts, and the locust birds. Nature is, however, ever mindful of her children, ever working for their welfare; her scales are admirably adjusted; a feather might turn the balance; but the feather is never there to do so.

In the case of the locust plague, utter ruin would undoubtedly overtake the African continent were no check brought to bear against this mighty scourge.

The African locust (*Pachytylus pardalinus*) or migratory grasshopper, of which I am writing, is a

yellowish-brown and grey insect, of about two inches in length; it is not conspicuously marked in any way, the wing-cases are slightly mottled with brown upon a silvery grey ground, and the folded wings beneath are semi-transparent, and of a greyish-yellowish colour.

There is but one species of this destructive locust, including a single variety of a slightly redder colour than the typical form, which I maintain to be the smaller of the two, as it is by far the most numerous and common.

The variety is usually turmed the "Strandveldt" (sea-coast) locust, but whether it is entirely confined to the sea-board regions I have not for a certainty assertained.

The vast flights of locusts which from time to time visit the Cape Colony, arrive in their Imago state (full grown) from the interior of the continent. Like other migratory creatures they are gregarious in their habits, consequently they are not distributed at random over the country, but in large bodies or swarms. So vast are the proportions of this scourge, and so dense their multitudes, that occasionally they will even darken the air, intercepting the suns rays, and casting a checkered shade over the earth. On fine summer days their flight is remarkably high, in fact at so great an elevation that the locusts appear as mere specks against the blue sky.

Excepting in the localities where they deposit their eggs, they never remain stationary for any length of time, but pass on from one part of the country to another, in search of "pastures new," and leaving in their wake ruin and devastation, a bare country without a blade of grass, where all before was green and flourishing.

In their travels the locusts frequently avoid high mountain ranges, preferring the low hills and valleys, where the pasturage is of a sweeter nature, to the long, rank grasses of the mountains. This is a fortunate circumstance; it is the "ill wind," for the stock farmers, deprived of their accustomed pastures for their numerous flocks, at once resort to higher latitudes as a refuge for their starving cattle.

In seasons of great scarcity, when the locust hordes have swept over the earth, depriving it entirely of its green mantle, and there is nothing left for man or beast, all creatures (including the human races of South Africa) take to locust diet. Stock of all kinds—the beasts of the fields, the birds of the air, and the fishes of the neighbouring seas and rivers—all resort to this practice, for they are in a great measure compelled to do so. It does not, however, in all cases prove a wholesome diet, for (excepting the feathered tribes) creatures do not at all times thrive upon it.

The horse will feed upon locusts with great relish, leaving his accustomed grazing grounds for the purpose of obtaining them, and for the time being becoming an insectivorous animal; yet, strange to say, after the locusts have deposited their eggs, they become injurious to the horse, and even poisonous, causing death in many instances.

As a rule, locusts do not travel during the night, excepting under extraordinary circumstances, but that they are able to do so, there can be no doubt.

To elude the attacks of several species of locust birds, the locusts will travel *day* and *night*, never ceasing to fly, until at length they are completely exhausted, refusing to take wing for several days afterwards.

In the year 1871, when some relations of mine were returning from the Diamond-fields, in Griqualand West, to the Colony, they had encamped for the night in the valley of the Orange River. On their arrival at this place no locusts were in the immediate neighbourhood; during the night, however, they were surprised on hearing the sweeping sound of their wings, and they came down through the still dark summer night in countless thousands, and all around could be heard that peculiar scratching noise which they produce by rubbing their limbs against their hard wing-cases; and on the morrow the locality was swarming with them, they were roosting upon every bush and shrub.

On another occasion, during the time in which some friends of mine were engaged in making a survey of a portion of Griqualand West, the locusts again made their appearance during the night in

great numbers, and attracted by the lights, many of them entered the tents of the surveyors, and were there decapitated for their audacity, after which they expressed their astonishment and indignation by standing on end of their headless bodies, and stretching their limbs forth into the air in a peculiar manner.

Many methods are resorted to by the farmers of South Africa to preserve their crops and pasture lands from the ravages of this winged scourge, which from time to time comes down upon the Colony. Perhaps the commonest of all, is that of burning grass and heaps of rubbish in the vicinity of corn fields on the approach of the locust flights, for the purpose of smoking them and scaring them away. Another method that is commonly practised, is to stretch long ropes across a field of corn, with many coloured flags attached to them at intervals; these ropes are supported by a man at each end, and also at various distances throughout their length, and are conveyed immediately above the growing corn, from one end of the field to the other. This contrivance has the effect of causing the locusts that are settled to rise simultaneously, and occasionally they will take flight altogether and leave the neighbourhood, apperently believing that a general movement has taken place in the whole swarm.

Locusts have a singular method of clearing off a field of corn, and leaving nothing behind saving the tall bare stems. On alighting, each locust will place itself upon the upright stem, immediately beneath the ear (or head) but not upon the ear itself, which would in most cases be unable to sustain the weight of the locust combined with that of its own. It will then, with its sharp teeth, cut the corn stem half-way through, after which the weight of the grain will cause the head to bend over and fall against its own stem. Suspended by the portion that has not been severed, it will fall immediately in front of the locust, who having thus secured its object, will at once commence feeding upon the young growing corn, and not until the grain of a corn field has been entirely cleared off will the locusts resort to feediug upon the leaves, leaving at length, nothing but the bare upright stems.

There is not, I believe, in the whole of South Africa, a more voracious tribe of grasshoppers than the locusts. With the exception of the time in which they are either travelling or sleeping, they never for a moment cease to feed with avidity. If wet or stormy weather prevents them from rising, they will devour the bark and soft wood, and even the twigs of the trees and shrubs on which they are roosting.

I have seen a locust with its abdomen fearfully mangled (severed all but in two pieces) climb to the summit of a shrub immediately afterwards, and there commence feeding as if no accident had occurred to it. The creature could not of course exist for any length of time, as the food which it consumed was diverted from its natural channel, and making its escape just beyond the thorax.

It has invariably happened that when the locust flights have come down upon the Colony, sooner or later they will certainly be followed by their hereditary enemies, the locust-birds. Months and even years may intervene, but in the end they have never failed to make their appearance.

The bird which first arrives upon the scene is in most cases the brown swallow-like locust-bird (*Glareola Nordmanni*). It will appear in vast flights, darkening the air in certain localities. The locust-eating stork (*Ciconia Alba*) will shortly follow, and occasionally the grey mottled starling (*Dilophus Carunculatus*) will accompany them in great numbers.

A migratory hawk may also be enumerated among the locust-birds, and also a greyish white swallow-like bird, nearly allied to *Glareola Nordmanni*,* will follow in vast multitudes. The two last named are, however, exceedingly rare within the boundaries of the Colony. The different species of locust-birds are not only gregarious in their habits, keeping together in large flocks, but like the locusts they are migratory as well, having no fixed abode or *habitat* in any particular

* From a much injured specimen forwarded by Mrs. Barber, I believe this greyish-white bird to be a species of *Glareola*. It is uniformly pale-grey above, and almost white beneath; the tail is but slightly forked; and the bill and legs black.—R. TRIMEN.

locality, but following the locust flights from one part of Africa to another.

By far the most numerous of all the locust-birds is the brown swallow-like species above named. It appears in multitudes second only to the locusts themselves, darkening the air like a cloud upon the horizon as they swiftly pass along. These birds are in every respect built for rapid flight. They have remarkably small bones, light bodies, and broad swallow-like wings and tails. In their flight they are also swifter than the locusts, never failing to overtake them, and according to their favourite custom feeding upon their prey in its passage through the air, and while doing so, at the same time cutting off with their broad beaks, the legs and wings of the locusts which they devour. These being severed in mid air fall to the earth like a shower of bright sticks and straws, forming a curious and novel sight, especially if by chance the traveller is passing beneath this gigantic "spread," and the *debris* from the locust-birds' *dinner table* is hurled down upon his hapless head in the form of myriads of legs and wings, bespattering perhaps his best hat or Sunday go-to-meeting jacket.

Locusts seem fully alive to the dangers which they encounter from the ravages of these birds, holding them in the greatest dread, and travelling *day* and *night* to get beyond their reach. In stormy weather, when pursued by these birds, and the locusts are unable to fly at a great elevation, they will take refuge by settling amongst the shrubs and grasses, creeping into them for concealment to evade their enemies. The birds, however, do not entirely confine themselves to their favourite method of feeding in the air. In rainy weather, when the locusts are prevented from rising, they descend to the plains and valleys, and there hunt them up, taking advantage of them also before sunrise when they are benumbed with cold, and unable to take flight.

The grey and white locust-bird (*Glareola sp.*) apparently differs only in colour from *Glareola Nordmanni*, and its general habits appear to be in every respect similar. It is, however, an exceedingly rare bird, and has upon one occasion only, as far as I

am aware, followed the locust flights to within the boundaries of the Colony.

I am unacquainted with the migratory hawk. This bird is probably *Tinnunulus cenchris* mentioned in Mr. Layard's "Birds of South Africa," as occurring in "Damaraland in countless thousands, and feeding upon locusts." Upon one occasion only has this hawk appeared within the Colony, and this was in the neighbourhood of Aliwal North, on the banks of the Orange River, where they arrived in vast multitudes, having followed the locust flights down from the interior with several other species of locust-birds, and when together they "came to grief," for the locusts proving insufficient, they fell short of food, and many of the birds (including the migratory hawk) died of hunger.

The locust-eating stork never attacks its prey while on the wing. These birds are by no means swift of flight, and prefer feeding upon the locusts before sunrise in the localities where they are roosting, or on stormy wet days when they do not rise at all.

It frequently happens when the storks follow the locust flights in great numbers from the interior, that another bird is found associating with them. This bird is also a stork, but of quite a different species. It is the "adjutant" (*Leptoptilos Crumeniferus*), a much larger bird, with long legs, and a powerful beak of nearly a foot in length. With the general habits of this species I am but slightly acquainted. A solitary specimen will, however, take up its abode with the storks, remaining with them for months together, accompanying them in their wanderings, and apparently taking the lead in all their movements, in fact constituting itself their leader. Upon two different occasions I have myself observed the adjutant in company with the storks. The natives, and also the Dutch colonists (who are equally superstitious), declare that there is something "uncanny" in this bird; and look upon it with an evil eye. They relate strange tales concerning it, and will tell you that it is exceedingly sagacious, that it will follow the sportsman in his hunting expeditions for the purpose of uncovering the game which he has shot, and hidden

away from the vultures, by covering it with grass or small bushes. This it will do, however, not with the intention of feeding upon it itself, but for its friends, the vultures and jackals. I cannot vouch for the truth of this statement. I have merely given it as it has, upon several occasions, been related to me. There may be something in it. I have seen so many instances of the wonderful sagacity of birds, that at all times I hesitate to cast aside as idle gossip any of these strange traditionary tales. The bird may have some ulterior object in feeding the vultures and the jackals, even as the "honey guide" (*Cuculus Indicator*) has in leading the bee-hunter to the hives of the wild bee. Possibly, like that bird, the adjutant may return to the spot to pick up the fragments that are left behind.

Many of the native tribes of South Africa feed on locusts, especially at certain seasons of the year, and are delighted at their advent.

The wandering Bushman is a locust-eater. He is moreover a thriftless and improvident creature, taking no thought for the morrow, and believing that the things of the morrow will be sufficient for themselves. Where he finds the locusts, there he captures and eats them, selecting, if possible, those that are filled with eggs, as they are considered a great delicacy, and roasting them on the coals of his fire, as he sits behind his rush-mat, which is propped up on the windy side, or perchance beneath some sheltering rock or cavern; where strange to say, this wild untutored creature has been amusing himself by making drawings and paintings of considerable skill. The Bushman has no fixed abode. He builds no houses, neither does he store up food for future use.

The Bakalahari, or Masaras, a tribe of natives inhabiting the regions of the Kalahari, Lake 'Ngame, the Zambesi, &c., are also locust-eaters. These people, though a much finer race, are not unlike the Bushmen in their general habits, wandering in a homeless manner from place to place, and sleeping where they have succeeded in killing their last head of game. Like the Bushmen, they construct no dwelling places (unless a shed erected with four sticks and a mat

or two can be called a house), neither do they tend cattle, sheep, or goats, but subsist by hunting, digging roots, eating locusts, white ants, &c.

With the Bakalahari, it is a great event when the locust flights make their appearance, a time of rejoicing. It is then that they may be seen collecting in great numbers for the purpose of obtaining large supplies of these grasshoppers. For many miles throughout the day they will follow on after the locusts, overtaking them in the evening in the localities where they settle for the night. Having accomplished this race, they at once set to work in earnest, working with all their might, digging locust-pits (large holes in the earth of several feet in length and breadth). These are to be filled with locusts, which are captured during the night, and also before sunrise in the early dawn, while they are sleeping or benumbed with the cold, and unable to take flight. In this work they all unite, men, women, and children, labouring incessantly until it is accomplished, or the pits all filled, after which they are covered in with earth and long grasses to prevent the escape of the locusts on the morrow. In this state the pits are left behind, whilst the Masaras again proceed upon their march, following up the locust flights for many miles, as they had done on the previous day, to repeat the same operation on the ensuing night. This work is continued with great perseverance for several days and nights in succession, until the Masaras have secured what they consider to be a sufficient supply to serve them for some months, after which they abandon the locust-flights, and return to the numerous locust-pits in which they have stored away their prey, when they find the locusts very much in the same state as when they were left, dull and stupified but not dead.

It is now their occupation to prepare these grasshoppers for their future use. Their clay pots and earthern vessels of various kinds are now in requisition. A small quantity of water is put into each, after which it is filled with locusts, and placed over a slow fire to boil, and in this manner they are steamed until they become of a reddish colour, somewhat resembling boiled shrimps. The locusts are then removed from the

pots, and placed upon mats, and exposed to the sun. When sufficiently dried, the legs and wings are rubbed off by hand, until they are smooth and clean.

Preparing locust meal is the next process. This is usually accomplished by grinding them upon flat stones with a round boulder, or pounding them in mortars made of wood. The meal is then stowed away in skin bags for future use.

This meal is light, and easy of transportation from one part of the country to another, which is an advantage to a wandering people like the Bakalahari. It is usually eaten in its crude rough state, without any further preparation, saving the addition of a little salt when this article (which is considered a great luxury) is procurable.

In times of long protracted drought and scarcity, many of the native tribes of South Africa, who do not at other times resort to eating locusts, are through want compelled to so. Amongst these may be enumerated the Kafirs, Basutos, Batlapins, Griquas, Hottentots, Korranas, &c. These people (or tribes) prepare the locusts in various ways, according to their different customs. The Basutos make a dish which they call "Bakoba." It consists of rather large balls made of locust meal, which are either baked or boiled over a slow fire. A thick porridge is another method in which they prepare this meal.

Locust diet is, however, by no means considered a wholesome food for human beings, and when through famine the natives are reduced to subsisting *entirely* upon it, many deaths occur through constipation and other ill effects.

The Dutch colonists occasionally collect these grasshoppers for the purpose of feeding their poultry. I once knew a Dutch woman who filled several large sacks with them for this purpose. The locusts were of course imprisoned alive, and after the lapse of some days she found her store rapidly diminishing in an unaccountable manner, and on examining it she perceived that the locusts were living upon each other, and that the half of her store had already disappeared.

Some years ago a French missionary, in Basuto-

land, succeeded in making what he considered to be an excellent condiment or locust-sauce. In appearance it resembled anchovy-paste. On several occasions it was pronounced to be a capital relish. Some of this locust-paste was, I believe, sent to Sir George Grey, who was at that time Governor of the Colony.

Occasionally it will happen that large flights of locusts are carried away by adverse winds, or by sudden storms, as the following incident will show.

Many years ago, during a season in which the country was suffering from one of these plagues, it happened upon one occasion that vast multitudes of locusts were travelling in the direction of the coast, and at the same time flying at a great elevation. Whether it was the result of a strong upper current of air, or that they were fleeing from their enemies the locust-birds, or peradventure in search of "pastures new," I cannot tell, but for days together they passed on over the Indian Ocean. In those days I was residing with my relations near the sea. We of course were anxious to ascertain the fate of the locusts, for none had settled in our neighbourhood, or returned to the shore. On visiting the beach, we found that many of them had been drowned, and were scattered upon the shore amongst the shells and sea-weeds, but these were as nothing compared to the myriads that had gone out over the ocean, and we marvelled much what had become of them. However, on the third and fourth days after their disappearance, our curiosity was thoroughly satisfied, for they came on shore in vast shoals, the beach for many miles (extending from the mouth of the Bushman's River to that of the Fish River, and from thence on into Kaffraria) was lined with the dead bodies of locusts. There was a band formed of their dead bodies, intermixed with the refuse of the sea, several feet in thickness and breadth, and the odour which pervaded the shore was unbearable.

The country was, however, saved from the scourge of locusts. They had met their fate by finding a watery grave. Some time afterwards I was told that many locust-birds had followed in their wake, but the birds never reached the coast; whether they perished for

want for their accustomed food, owing to their commissariat supplies having been shipwrecked, I cannot say. At any rate, if they were reduced to the common grasshoppers of the country, their fate must indeed have been deplorable, for they are utterly insufficient to feed the multitudes of locust-birds which usually follow the locust-flights in their migrations.

The enemies of the locust are innumerable and of widely differing species. I have seen the trap-door spider (*Nemesia sp.*) when a swarm of these grasshoppers were passing by, rush suddenly from its den, seize a locust and drag it headlong down into its gloomy hole, never again to see the cheerful light of day.

I have not seen the Ichneumons or other parasitic insects which infest the locusts, but two species of these flies have on different occasions been described to me. One is slightly larger than the other, and nearly allied to a Blue-bottle, being somewhat hairy and of a grey colour, with a large reddish head. This fly is said to deposit its egg beneath the thorax of the locust. The other species is described as an Ichneumon-fly of a darker colour. It is not so numerous as the grey fly, but exceedingly active and rapid in flight, it passes swiftly over its victim, apparently scarcely touching it with its ovipositor, nevertheless leaving its egg behind, either beneath the thorax or in the neck of the locust.

One or two specimens of these flies which were sent to my friend Mr. Trimen, of the South-African Museum, are described by him as being a "two winged insect of the genus *Tachina*, which is of the same family (*Muscidæ*) as the common house fly, and not unlike it in appearance." Now whether these flies are one and the same, and whether they are the insects which destroy the locusts, I am not prepared to say. My only reliable information on the subject is that a single egg is deposited in the soft part of the locust's body, and that the larva of this parasite in subsisting upon the locust will desist from preying upon its vital parts until it has completely finished with its victim. Having no further use for it, it will then eat

its way through the head of the grasshopper, thereby causing its immediate destruction, and at the same time making its escape from the dead body.

Locusts affected, or rather doomed, by this parasite become of a much darker hue than their natural colour, at the same time losing all their sprightliness, and performing none of the natural functions of their lives.

Large swarms are occasionally entirely swept off by the ravages of this parasite, so great is the mortality, that at each locality where the locusts pass the night the earth is strewn with their dead bodies.

Locusts usually pair sometime after midsummer, and the females deposit their eggs in the early part of winter, frequently as late as June, selecting fertile valleys, where the soil is somewhat sandy and free from gravel, and where the sun's rays are not obstructed by either mountain ranges, high hills, or cliffs. For this purpose they delight in the wide extensive plains of the Orange Free State and Transvaal territories, where the soils are generally light and free from gravel or heavy clays.

The female locust, after the manner of other grasshoppers, bores a small hole or cavity in the earth, of somewhat more than an inch in depth, and in this chamber her numerous eggs are deposited. In shape the egg of a locust is oblong, of a pale orange colour, and very slightly tapering to a point. Within the earthen cavity or nest, the eggs are neatly encased in a film of transparent tissue, which is a means of preventing the sand or earth from intermixing with or injuring them.

Female locusts will at certain seasons separate themselves from the males, and in large flights take their departure, going in search of sandy soil, or a suitable locality in which to deposit their eggs. At this period of their existence they are perfectly harmless to pasturage or corn lands, not caring to settle for the purpose of feeding, but pursuing with the greatest diligence the object of their search.

The female locusts after having deposited their eggs' become dull and sluggish and of a darker colour, and seldom leave the valleys where they have laid their eggs, many of them perishing almost upon the spot.

The male locusts never survive the frosts of winter, consequently the life of a locust does not extend over more than nine or ten months, but the frail and delicate locust egg, which lies hidden in the soil, will endure for many years, like the seeds of certain plants.

It occasionally happens that when new corn lands are turned over by the plough, and the virgin soil for the first time broken, that the eggs of locusts which have for many years lain buried in the soil, will by this means become exposed near the surface of the earth to the influence of the season, and young locusts will make their appearance within the vicinity of the ploughed lands, whilst not a single specimen will be found in the adjacent country.

Young locusts are called in South Africa "*Voet gangers*" (travellers afoot). This appellation was given to them by the early Dutch settlers. It is an appropriate name, and they have retained it ever since.

The voet gangers quit their ova-dwelling-place, wherein they have lain for some months (as a general rule), shortly after the early spring rains have fallen. On first leaving the earth they are of a light colour, approaching to white; on exposure to the sun's rays, however, they rapidly become black, or very nearly so. They seldom make their appearance until after the spring rains have fairly set in, and the young grass is springing up in all directions, when they may be seen in small black patches in the vicinity of the holes from whence they have made their exit, sunning themselves and looking pleased with the new grassy world that is all before them. They are at this early stage lively little grasshoppers of not more than a quarter of an inch in length. They do not, however, remain in detached parties, but rapidly amalgamate, becoming large swarms and roosting together upon the shrubs and grasses. Their appearance, however, is by no means certain, it entirely depends upon the season and the fall of rains, making it earlier or later, or not at all. Should dry weather set in, and the earth (being deprived of its early spring showers, should become parched and hard on the surface) no young locusts will be hatched. The eggs are, however,

not lost, as might naturally be supposed, but merely standing over as it were (lying dormant) awaiting the event of better times.

A relative of mine, who was farming in the valley of the Fish River, was surprised to find on one occasion after heavy spring rains had fallen, a large swarm of young locusts on his farm. No flights of Imago locusts had visited the neighbourhood for at least three years, consequently the eggs had lain dormant in the earth during the whole of that period. This peculiarity pertaining to locust eggs is well known to the inhabitants of the Orange Free, State and the Transvaal, where locusts and droughts are more prevalent than they are within the Cape Colony.

A curious tale concerning locusts' eggs is told in the first named country. It is too well authenticated to admit of a doubt, and goes far to prove that, like the seeds of plants, the eggs of these destructive grasshoppers will remain in the earth uninjured for an indefinite period.

In the autumn of the year 1854, the neighbourhoods of Bain's Vley, Bloemfontein, Hartebeest's Hoek, and the valley of the Modder River were visited by vast flights of female locusts. They were evidently seeking a locality where sandy soil predominated for the purpose of depositing their eggs, and accordingly in the vicinity of these places, where the soil was light, it was filled with multitudes of their eggs. On the ensuing spring, a few young locusts made their appearance, but the season being unfavourable, they were speedily destroyed by their numerous enemies. None of them ever reached the Imago state. From that time until the year 1861, for some reason (probably a succession of dry spring seasons), no locusts made their appearance in these neighbourhoods. However, in the spring of the last-named year, after heavy rains, vast swarms of young locusts came forth from the earth, "and they filled up all the land," much to the astonishment and chagrin of the inhabitants, for these destructive "voetgangers" cleared off every blade of grass, and the farmers were compelled to remove their stock in search of pasturage.

The Stanley, or blue crane, of the colonists

(*Tetrapteryx paradisea*), is very destructive to the eggs of locusts, exhuming and devouring them in great numbers. This bird frequents the plains and valleys where the eggs have been deposited, and then with its long sharp beak discovers the cavities in which they lie hidden. It is interesting to observe a large flock of these graceful cranes industriously probing the earth for hours together in search of locust eggs.

Voetgangers are a terrible scourge to the country whereever they occur, clearing off fields of corn and gardens of vegetables, and leaving devastation and ruin in their wake—in fact, destroying every green thing, not only in the cultivated fields, but throughout the length and breadth of the land, to the utter destruction of all pasturage, leaving no food for cattle. They are considered worse even than the Imago locusts themselves.

The manner in which voetgangers travel is by no means slow. They do not walk rapidly or run along the earth, but proceed by a succession of short quick leaps, or hoppings. When no long grass or bushes obstruct their passage, and more especially when a footpath or wagon road offers them the facility of travelling, the progress which they make is considerable, and many miles will be traversed in the course of a day.

Many methods have been adopted by the farmers and agriculturists to save their crops and pasture lands from the ravages of the young locusts, or voetgangers, as they are more commonly called, on their approach. Large heaps of straw or dry grass and weeds are collected. These are piled in heaps in the vicinity of the corn-fields or gardens and set on fire, for the purpose of keeping off the invaders, who are, it will be remembered, wingless grasshoppers.

Another method commonly practiced by the natives is somewhat more ingenious. When the voetgangers make their appearance in the vicinity of their lands, they collect in considerable numbers, men, women, and children, each individual (according to "Birnam Wood" fashion) taking the branch of a tree in his or her hand, and forming themselves into a triangle between the locusts and the corn fields. They at once commence operations by shouting and screaming,

kicking up the dust, &c., and with all their might at the same time slashing away in every direction, and doing battle with the branch which they have brought with them for the purpose. By this contrivance they destroy not only great numbers of the voetgangers, but the triangle of human beings has likewise the effect of causing the swarm to separate on each side of the cornfield, and to pass on, leaving the crops unmolested. It will frequently happen, from the enormous size of the swarms, that this work has to be continued for days and even weeks together, leaving the people no rest excepting during the time in which the locusts are roosting, or in which rainy weather may occur.

Large droves of cattle and flocks of sheep, are also brought to bear against this scourge. These are driven over the young locusts in the localities where they are roosting, either during the night or on the early morn, when great numbers are destroyed by the trampling of the cattle. Nevertheless it is marvellous to find that afterwards they appear to have escaped the ordeal, and that the vast hordes are not perceptibly diminished.

All these methods are, however, comparatively useless when the locusts occur in vast multidudes, filling up the whole country, when swarm after swarm has to be contended with, and the cry is still "they come." It is then all but useless to strive against them. Their numbers are overwhelming and cannot be driven away; it is then that the locust-birds alone are enabled to make any impression upon them.

There is a peculiarity pertaining to young locusts which I must not omit to mention. No sooner have they made their appearance from the earth and have obtained a slight degree of strength than they will at once take up a northern course, travelling always towards the interior in the direction from whence their progenitors came. Nothing will stay their progress northward. Mountain ranges, forests, rivers, &c., may intercept, causing them apparently to alter their course; nevertheless it will ultimately be found that they will surmount all these difficulties in their travels to the interior of the continent.

The manner in which they occasionally cross broad rivers shows an amount of reasoning power in these young grasshoppers which is surprising. An instance of this kind took place on the Vaal River (Griqualand West) in the spring of the year 1871, shortly after the discovery of the Diamond-fields. The country was at that time swarming with young locusts; every blade of grass was cleared off by them. It one day happened, however, that a vast swarm of these voetgangers made their appearance on the banks of the Vaal River. They were evidently in search of a ford for the purpose of crossing to the opposite bank, which was no easy matter for these small creatures, as the river was slightly flooded at the time; but, as I have already stated, nothing will stay them in progress northwards. For several days the locusts travelled up the stream, in the course of which they paused for some time at a sudden bend in the river, when a number of rocks were cropping out, as if in doubt whether to attempt a passage at this place. However, they at length passed on, evidently with the hope of finding a better ford, in which apparently they were disappointed, for in three days afterwards they returned to the same bend of the river, and there on the morrow plunged into the stream in vast multitudes, where together with the assistance of a favourable current and the sedges and water plants which grew upon the projecting rocks, they managed to effect a crossing. Great numbers were, of course, drowned and carried away by the flooded river, as they were hurled from one projecting rock to another, but these casualties do not count when myriads of locusts are pursuing their march northwards. Voetgangers have been known to attempt the passage of the broad Orange River during the season of its flow, when it was several hundred yards in breadth, pouring their vast swarms into the flooded stream, regardless of the consequences, until they became heaped upon each other in large bodies, and as the living mass accumulated large pieces of it were swept away by the strong current from the bank to which they were clinging, and as they tightly grasped each other and held together, they became floating islands of living

locusts, which were continually hopping and creeping over each other as they drifted away. Whether any of the locust-islands succeeded in reaching the opposite bank by mere chance is difficult to say; probably some of them were washed on shore again. They are by no means rapid swimmers, but they do not perish easily in water, the practice which they have of continually changing places, and hopping and creeping round and round upon each other, is a means of self-preservation of great advantage to them.

It is a common practice for young locusts to form a bridge over a moderately broad stream by plunging indiscriminately into it and holding on to each other, grappling like drowning men at sticks or straws, or, in fact, anything that will assist them in floating that comes within their reach, whilst those from behind are eagerly pushing forward over the bodies of those that are already in the stream, and hurrying on to the van, until at length by this process they reach the opposite bank of the river, and a floating mass of living locusts is stretched across the stream, forming a bridge over which the whole swarm passes. In this ingenious contrivance but few, comparatively speaking, are drowned, as it is not the same individuals who remain in the stream during the whole time in which the swarm is crossing, but they are continually changing places with each other; those that are beneath are endeavouring to reach the surface by climbing over each other, whilst those on the surface are, in their turn, being forced below. Locusts are likewise exceedingly tenacious of life, remaining under water for a considerable time without injury. An apparently drowned locust will revive beneath the warm rays of the sun, if by chance it reaches the bank or is cast on shore.

Voetgangers will occasionally march through towns and villages. I have seen them doing their best to scale the wall of a stone building, rather than be thwarted in their progress towards the interior. On one occasion, when the young locusts were crossing the Fish River, where its banks were precipitous on both sides, and they had probably been unsuccessful in finding a suitable ford, they at length plunged in over the steep banks, regardless of their chances of

scaling the opposite side, which was equally precipitous. This took place on one of the long reaches of the Fish River, where the water was still and deep, and the current imperceptible. Regardless of all this, however, in they went, pell-mell, over the wall-like bank, hanging together in some places on the roots of plants and grasses over its steep sides, and dropping off into the water in countless thousands, forced on by the myriads that were approaching from behind, until at length in their accustomed manner of forming a bridge they reached the opposite bank. Here they found that all their efforts to scale its steep sides were in vain; they could gain no footing upon it, it was too sandy in its formation, the earth gave way beneath their feet, and they invariably fell back again into the river. It was in vain to return to the bank which they had descended, for it was equally sandy and steep; they were fairly entrapped in the water. It was a hopeless case for the poor voetgangers; the whole swarm was swamped in the river, for there was no current to bear them away, and so they perished in one huge mass, forming almost a barrier across the stream where they lay rotting for days together, rendering the water most offensive. The fish died from its poisonous effects, and floated on the surface, adding to the mortality which already existed, and the effluvia which arose from the river were beyond endurance, so that no one could approach the spot to gaze upon the scene of desolation.

All the different species of true locust-birds breed in the vicinity of the young locusts, on which they entirely depend for food for their young, and not upon the imago locusts, that have wings and are never stationary, but continually moving over vast regions of country. Amongst the numerous species of locust-birds I have seen within the Colony, only the nests of the grey starling. Those of several other kinds have, however, upon different occasions been described to me by people of undoubted veracity.

Before building, the locust-birds invariably ascertain beyond a doubt in what locality the locusts have deposited their eggs, and there for the time being they take up their abode, building their nests in various manners according to the habit of their species.

The birds are in most cases enabled to calculate to a certainty the exact time in which the young locusts will make their appearance, so that by the time the process of nest-building and incubation have been accomplished, food will be abundant for their young. Notwithstanding all these precautions, it will occasionally happen (from the habit which the young locusts have of travelling northwards) that dire calamities at times overtake them, as will be seen by the following incident, which occurred to the grey starlings on the Fish River heights.

These birds had followed the locust flights from the interior into the Colony, and there, according to their custom, in the valleys where the locusts had deposited their eggs they built their nests in the following spring. For some reason or other, they were late in nest-building; the spring rains had already fallen, and the young locusts in certain localities were making their appearance, while the birds where yet busy with their nests (which take them some time to complete), collecting small sticks, straws, feathers, &c., and packing them into the thorn trees (*acacia horrida*), which are common in that neighbourhood. Their labours were, however, all in vain; for by the time their young were hatched the voetgangers were leaving the neighbourhood, some of them having attained their imago state (they were winged grasshoppers). The starlings found their task a hard one, for as the time passed on and their young were still unfledged, the distance between their nests and the swarms of young locusts was daily increasing, the old birds were unable to satisfy the cravings of their offspring. It was surprising to observe with what diligence they pursued their arduous labours, doing their utmost to save their famishing young. The locusts had already crossed the Konap River, and were twenty miles away from the nests of the starlings. There was but one alternative left to the starlings, and this was either to perish with their young or save their lives by abandoning them and following the locusts. Another week would have enabled the young birds to have accompanied them, but this was not to be. They were left to perish in their nests, not one of the old starlings remaining

behind. The thorn-tree valley, with its countless thousands of nests, became "the valley of the shadow of death;" it was a mournful sight to look upon, and the blue-bottle came in for his share of the spoil.

Upon another occasion, in the same neighbourhood, but where the thorn-trees were less numerous, the starlings packed so many of their nests (it is their usual practice to build them adjoining each other, making the outside of one nest form portions of the structure of several others, and thus saving labour) into the branches that the trees were unable to support their burden. Stormy wet weather set in, and several of the largest trees came crashing down, and great was the confusion of broken nests and broken eggs. The case was quite hopeless, and the birds belonging to the nests in the trees that were blown down abandoned them in despair.

The locust-eating stork is the largest of the true locust-birds, and like other locust-birds it builds in the vicinity of the young locusts. I have never met with any of their nests within the Colony. In the Orange Free State, however, and also in the regions of St. John's River and the Bashee, they have been seen in great multitudes, always upon the summits of rocky hills or ridges, the nests being upon the earth and not amongst the rocks.

Like other species of locust-birds, the brown swallow or plover-like form breeds in the vicinity of the young locusts, I have not seen their nest. It is said to resemble that of a plover, and the eggs are described as mottled.

The nests of the white locust-bird and of the locust-hawk I know nothing of. They could not, however, rear their numerous young without the assistance of young locusts.

The scorpions of South Africa also fatten and thrive upon locusts. On hot, sunny days, when the locusts are feeding, these creatures come forth from their hiding-places and carry off great numbers of them, not only of the voetgangers, but the winged grasshoppers also. The scorpions hunt by stealth and spring upon their prey, after which it is conveyed to their dwelling-places beneath the rocks.

As I have already stated, locusts are not entirely

vegetarians, for occasionally they will eat each other ; but although the Voetgangers are rather inclined to cannibalism in hard times, it is invariably either the halt and the maimed, or those that are accidentally killed, that are devoured. They will, however, travel side by side in almost a starving condition without showing any cannibal propensities. Young locusts are not impartial to flesh. If during hard times the carcases of animals are exposed, they will clear the bones of whatever flesh they may have had upon them. In times of drought and great scarcity they will devour anything that comes within their reach. Several of my friends who were returning from the Diamond-fields in the year 1871 found these grasshoppers a perfect torment; they were even prevented from taking a siesta beneath the shade of their wagons by the nibbling of these insects, and it was with the greatest difficulty that they prepared their food ; for the locusts were in everything, devouring with avidity their bread, meat, meal, tea, sugar, coffee, tobacco, &c. ; nothing came amiss to them, and the maimed and slain amongst them were at once set upon and eaten up by their companions in a most remorseless manner.

Young locusts remain voetgangers for about four months, during which time they change (or cast) their skins five times. This operation is very quickly accomplished. The young locust suspends itself to a twig or grass-stem by its hind legs, head downwards, and by inflating its body to a slight degree, together with several effective little jerks, the skin separates along the head and thorax, and the grasshopper creeps out of it, with its new jacket on, leaving the cast-off garment upon the twig. After performing this operation for the last time, they arrive at their imago state (becoming winged grasshoppers). The individuals who first acquire wings do not leave the general swarm, although their wings would enable them to do so, but remain with it until such time as they have all arrived at maturity, when the whole body will take wing together. The swarms are of various sizes, the young locusts of which they consist being usually of about the same age. In cases, however, where large bodies or swarms of different ages are mixed, the full-grown locusts will suddenly take wing and travel

northwards, leaving their companions the voet-gangers to trudge along behind until such time as they are enabled to follow.

By the middle of the summer the young locusts have usually acquired their wings, after which they invariably all take flight and speedily disappear, leaving the Colony and travelling northwards towards the interior of the continent, from whence their progenitors came. In most cases they do not travel alone, they are accompanied by their hereditary enemies, the locust-birds, who follow them throughout their wanderings. These birds, after having built their nests and reared their young in the vicinity of the young locusts, are also in a fit state to accompany them in their flight, and together they vanish from the scenes of their late labours, not a single specimen of either locusts or birds remaining behind in the Colony.

So much for locusts and locust-birds. For the present I have finished. I have sent my locusts and birds away into the interior "across Africa," and "through the Dark Continent," and I am perfectly indifferent as to what their fate may be. Not so, however, with regard to that of my paper. I cannot send it away in like manner, without previously offering my most sincere thanks to the friends who have materially assisted me in its preparation, not only by collecting valuable information from various sources, but by giving me the result of their own observations as well. Amongst these I must enumerate Roland Trimen, Esq., F.L.S., F.Z.S., &c., &c.; Commandant Bowker, F.G.S., &c., &c.; Frank Orpen, Esq. F.G.S., and Surveyor-General of Griqualand West; A. H. Bain Esq., F.G.S., of Bain's Vley; S. Edwards, Esq., J.P., &c.; my brother and sister-in-law, Mr. and Mrs. Octavius Bowker; also my brother J. B. Bowker, Esq., of Alstonfields; and last, but not least, my two sons, Frederick Hugh Barber and Henry Mitford Barber, who, during their hunting expeditions into the interior amongst the natives, have from time to time given me the result of their observations, as well as many of the anecdotes that are embodied in this paper.

XXI. *A Storage-Reservoir in the Achterveld.*—By John G. Gamble, M.A., M. Inst. C.E.

[Read 29th October, 1879.]

[NOTE.—The wall diagrams referred to have not been printed, but it is believed that the nature of the work can be understood from the remarks and from comparison with a map of the Colony.]

The small village of Brandvley is situated in the division of Calvinia, about half-way between the villages of Calvinia and Kenhardt. It was laid out in 1876 by Mr. William de Smidt, jun., M.L.A., The writer of this paper camped on the site of the village while Mr. De Smidt was surveying there, and at that time the inhabitants consisted of two trek boers with their families, who lived in tents. One reason for the choice of the place was the existence of a narrow "poort" above the site of the village, through which poort a branch of the Zak River flows in time of flood. Mr. De Smidt's idea was to block up this poort so as to form a lake above the poort whenever there was water running in that arm of the river.

The Zak River above this point drains an enormous area of country, about 14,000 square miles. The drainage area extends, as may be seen on the map of the Colony, from close to Beaufort West on the east, nearly to Calvinia on the west, and from Carnarvon to Sutherland. This area, 14,000 square miles, is about equal to the area of Holland or to the area of Switzerland. The Beaufort West reservoir has only a drainage area of sixty-five square miles, or one two-hundredth of the size of the drainage area of the Zak above Brandvley. The Vartry reservoir, which supplies Dublin, has a drainage area of only twenty-two square miles, or one six-hundredth of Brandvley; and yet in spite of this enormous area the river only runs occasionally; in fact, in some years it has not run at all. This year, 1879, it ran in January, and ran again in May for fifteen consecutive days through

three distinct channels. No accurate record has been hitherto kept of the number of times the river has run and the depth on each occasion, though it may be hoped that some one of the villagers will undertake a record for the future. The annual rainfall is probably under six inches. How much of this quantity this layer of water, 14,000 square miles by six inches deep, runs off the grouud? In India, in the beginning of the monsoon, when the earth is parched, about five per cent. of the rain runs off. If only five per cent. runs off the drainage area of Brandvley, yet this quantity would be enough to fill thirty such reservoirs as the one already constructed at Brandvley. In India, as has been said, only five per cent. runs off at the beginning of the monsoon: that is, ninety-five per cent. sinks into the ground or is evaporated. Towards the end of the monsoon the earth becomes saturated, and seventy-four per cent. runs off. In the Karroo districts the rain falls chiefly in thunderstorms, and between the storms the sun shines out and dries up the surface, so that the soil does not remain saturated. I was informed that though the Zak River frequently ran at Brandvley, yet that most of the water which passes Brandvley is absorbed by the wide flats about Onderste Doorns, and that it seldom reaches Kenhardt. The Hartebeeste, which is the name of the river between Kenhardt and the Orange River, runs occasionally, but the water in it is chiefly supplied by tributaries to the eastward of the Zak.

The late Commissioner of Crown Lands approved of the construction of a reservoir at this site, and Mr. William de Smidt was instructed to make a survey of the site. The wall diagram (1) is an enlargement of his survey. The design of embankment (wall diagram 2), as well as a short specification of the points to be observed in its construction, were given by the writer. The distance being great, the work somewhat small, and the Government not having thought fit to give the writer any staff, personal supervision on his part has been impossible. The work, however, has been inspected from time to time by Mr. De Smidt, who has been engaged in surveying Crown lands in that neighbourhood.

As there is a rock foundation right across the "poort," it would have been a very favourable position for a masonry or concrete dam. Masonry dams are vastly more satisfactory than those of earthwork, though they are generally costly in the first instance. Masonry or concrete dams, if made to proper dimensions with proper materials and founded on rock are perfectly safe. Water may pass over them and do them no harm, and even if they leak it is no great matter. The Barrage du gouffre d'Enfer on the Furens river, a tributary of the Loire, 180 feet high, is perhaps the finest work of the kind anywhere but for some years after it was first made there was a considerable amount of infiltration through the masonry, though it was solidly built and well flushed up. This infiltration has now stopped, and was never any cause for alarm. In the case of an earthwork dam, on the other hand, no water can run over the top, and even a small leakage is a sure sign of trouble; in fact, even the best made earthwork dams are uncertain things. The great distance of Brandvley from the coast would, however, have made the sending of skilled labourers, as well as the carriage of Portland cement, very expensive and earthwork was adopted instead.

The first operation connected with the work was to cut two trenches in the rock across the poort parallel to the line of embankment. These trenches were then filled with puddle clay. The object of the trenches is to dovetail, as it were, the work into the solid rock, to prevent the tendency that water has to creep along between two surfaces that are not homogeneous, and also to check any leakage there might be through fissures in the more weathered upper surface of the rock.

The material in the embankment was specified to be of three kinds. The best clay that could be got was to be put in the central core. It was to be put on in layers six inches thick, each layer being well wetted and trampled before the next layer was put on; in fact, it was to be made as close an imitation of a proper puddle core as the materials at hand and the inexperience of the workmen permitted. The next best material was to be put between the

central core and the inner slope and was to be trampled as much as possible. The portion of the bank between the central core and the outer slope might be made with what had been rejected from the other two portions, and stones or boulders might be used in it to a moderate extent. If, during the progress of the work, the surface of any layer had become hard or smooth, it was to be opened and dug into with a pickaxe before the next layer was laid upon it.

Those who have travelled up country and have noticed the boer-dams will remark that the slopes here drawn are much flatter than the boer thinks necessary. The inside slope is three horizontal to one vertical, the outer slope two horizontal to one vertical. These slopes are not by any means too flat, the tendency of waterworks engineers in England at present is to make the slopes of large dams still flatter. The boer, however, makes the serious mistake of using very steep slopes, frequently steeper than one to one. It is not merely that there is thereby a less weight of material to withstand the pressure of the water, but the wet clay will not stand at these steep slopes and slides down to its own slope, or rather curve of repose.* Moreover, the beating of waves undermines a steep slope very quickly. It is mainly to protect the bank against the action of waves that the inside slope should always be covered with pitching stones, or straated, as it is called in South Africa. The inside slope at Brandvley is specified to be covered with nine-inch rough rubble pitching, and the interstices to be filled with broken stone. The parapet wall is an additional protection against wave action.

Trees should not be planted on a reservoir bank, for the roots of trees extend a long distance, and when they decay, or even before that, they form channels along which the water finds itself a way.

The supply is given through a channel, three feet

* An example of the misconceptions on the subject of dams may be given from a letter written by a Government surveyor, recommending to Government a site for water-storage. This gentleman says: "There will be very little strain on the embankment, *as the ground above it has scarcely any fall worth mentioning!*"

wide and six feet deep, cut in the rock at a nek or depression close by. The writer had recommended the use of a siphon, but Mr. Wm. de Smidt suggested the present arrangement, which is quite secure, and is perhaps less trouble than a siphon. The farmers of this country are in the habit of laying a pipe through an earthwork bank. This is a fruitful source of danger and should never be permitted. The unequal pressure of the different parts of the bank is almost sure either to break one or more of the pipes, or to cause the spigots to be drawn from out of the sockets. A leak is immediately established, and the failure of the dam is certain. The matter is aggravated when, as is frequently the case, the sluice cock controlling the pipe is at the outer end. In this case closing the sluice cock of course increases the action of the leak. If the farmer will put a pipe through his bank, let him put his sluice cock on the inside, and then if a pipe or a joint breaks he can stop the entry of the water into the pipe and check the leak. But, as was said before, pipes should never be laid through a bank. Even if they do not break or draw, the water follows along the outside of them and prepares the destruction of the dam. For large dams the approved method of supplying water is to drive a tunnel through the solid ground at the side; for dams of small size a siphon is the best. Few sites have the advantage that Brandvley has of a narrow "nek" close by that can be cut through at small cost.

At present, when the reservoir is full it overflows at its eastern side as well as through the adjacent "nek," through which the supply channel passes. It is however suggested that an additional bank should be made at the eastern side. If this is done care must be taken that sufficient outlet is left at the adjacent nek and round the ends of the new bank for the storm water that may come in.

The special reason for proposing this new bank is on account of the shallowness of the reservoir. Though the area at present covered by water when the reservoir is full is two square miles, yet the mean depth is scarcely more than five feet. The bank proposed, a low bank nearly a mile long and five feet

high, would give an additional two feet of mean depth, and would increase the area to three square miles.

Under the burning sun of the Karoo plains evaporation goes on very rapidly, and depth is all-important. A German writer * says that the annual evaporation in the African deserts is probably 300 inches! Mr. A. B. Brand, the engineer for the Beaufort West reservoir, is of opinion that the average daily evaporation in the Karoo is about a quarter of inch. Thus the yearly evaporation would be ninety-one inches. At Brandvley the evaporation has so far not proved so great as might have been expected. Mr. De Smidt reports that during the three months from the middle of January to the middle of April no water came into the reservoir, but yet the surface level was only lowered two feet. No water was used for irrigation, as the supply channel was not then finished, and if the bank was well made, as I believe it was, the percolation should be inconsiderable, so that this twenty-four inches was the loss by evaporation in three hot months, which is less than might have been expected. Possibly the skies were occasionally cloudy, or calm weather prevailed, both of which would be unfavourable to evaporation; and clearer skies or windier weather might give a different result.

Mr. Wm. de Smidt reports the embankment to be standing well, though there was some settlement when it first filled. This will generally be the case even in banks made by experienced hands. The contractor, in making this bank, found it necessary to leave a gap to be finished at the last, so as to leave an opening for any water to run past. It is very likely that the filling in of this gap was done in a somewhat hurried manner, and that the principal settlement is at that point.

One feature of the Zak River is of considerable importance to Brandvley. This is that the eastern or main stream is deepening its bed, and there are falls or rapids upon it which are gradually working back up stream. It is feared that if the eastern branch is allowed to deepen itself too much, the whole of the

* Hagen Wasserbankunst, Vol. i., p. 20.

water will be taken by it, and none run by the western branch into the reservoir. Hence it has been thought desirable to make obstructions in the bed of the river to check this tendency to scour.

The cost of the work, including inspection, has been £670, of which £90 was subscribed by the purchasers of the village lots, and £580 paid by the Colonial Government.

Works of water-storage are a stern necessity in South Africa; sound construction is rarely met with. The writer needs therefore make no apology for bringing before the society this account of a somewhat small work. Let us hope it is only a beginning of greater things.

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THE TRANSACTIONS

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[1879—80.]

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1881

COUNCIL OF THE
SOUTH AFRICAN PHILOSOPHICAL SOCIETY

For 1879—80.

Elected 1879, August 8.

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For 1880—1881.

Elected 1880, July 30.

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* The Rules of the Society provide that the President's office cannot be held by the same person for more than two years consecutively.

MINUTES OF PROCEEDINGS.

Ordinary Monthly Meeting.

WEDNESDAY, August 27, 1879.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Seventeen members and eight visitors present.

In the absence of the General Secretary Mr Guthrie was appointed by the Chairman Secretary for the meeting.

The Hon. C. Abercrombie Smith exhibited a specimen of the Fern *Aneimia Dregeana*, found in the Perie Bush, in the King William's Town Division; and Mr Bolus remarked that this example was interesting as being the first he had seen from a locality within the limits of the Cape Colony,—the species having hitherto been regarded as peculiar to Natal.

Mr Gamble exhibited Prof. Fuller's Spiral Slide Rule and Dr Everett's Proportion Table, and explained their construction and use.

Mr C. Lloyd Morgan read a paper entitled "Notes on the 'Singerjee' Cicada (Platypleura capensis)", treating specially of the musical apparatus of the male insect, and the ovipositor of the female.

The Acting Secretary read a communication from the Rev. C. G. Büttner, entitled "Contributions to a Comparative Dictionary of the Bantu Languages."

Part of a paper by Mrs F. W. Barber, entitled, "Locusts and Locust-Birds" was then read; the remainder being held over until the next meeting.

Ordinary Monthly Meeting.

TUESDAY, September 30, 1879.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Present, fourteen members and four visitors.

Mr Lewis, of the South African College, Cape Town, was duly elected an Ordinary Member; and Colonel Owen Lanyon, C.M.G.,

Acting Administrator of the Transvaal, and Colonel Charles Warren, R.E., Acting Administrator of Griqualand West, were duly elected Corresponding Members.

Mr Guthrie gave notice that he should move at the next meeting the following motion, vid.: "That Corresponding Members, coming to reside within the prescribed limits, may become Ordinary Members by paying their subscriptions, without further election."

Mr Bolus exhibited a plant of the genus *Schizoglossum* (Nat. Ord. Asclepiadeæ), which he believed might be possibly new to science. It was certainly new to him as a plant indigenous to the Cape Town district.

Dr T. Hahn exhibited a chronometer-watch formerly presented to the illustrious Humboldt by the King of Denmark.

Mrs F. W. Barber's paper on "Locusts and Locust-Birds" was read to its conclusion. In the discussion which ensued, Mr Trimen briefly stated the circumstances under which he had suggested to Mrs Barber and other residents in the Colony or the neighbouring territories the interest that would attach to trustworthy observations and notes on this subject,—more particularly in connection with the elaborate inquiry instituted by the United States Entomological Commission into the history &c., of the allied destructive insect known as *Caloptenus Spretus*, or the "Rocky-Mountain Locust." Mr Gill, Mr Bolus, Mr Gamble, Mr Guthrie, and Dr T. Hahn, also took part in the discussion; the gentleman last-named stating that, in Damara-land, the brown eagle (*Aquila nœvioides*) was in the habit of killing the locusts; but that he could not say whether it ate those insects.

The President read Mr Hyde Clarke's paper "On the Languages of the Mozambique and of the South of Africa in their relation to the Languages of Australia." Dr T. Hahn had not concluded his remarks on this memoir when the meeting adjourned.

Ordinary Monthly Meeting.

WEDNESDAY, October 29, 1879.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Nineteen members and eight visitors present.

Messrs F. F. Rutherfoord, G. Kilgour, M.I.C.E., F.R.G.S., and F. Ayers were duly elected Ordinary Members of the Society.

The Secretary called the attention of the meeting to some

valuable books presented to the Society by the Vice-President, His Excellency the Rt Hon. Sir Bartle Frere, Bart., vid.:—

(1) An extra volume (No. 168) of the *Philosophical Transactions of the Royal Society*, containing full reports on the collections made in Kerguelen's Land and Rodriguez by the Naturalists attached to the Transit of Venus Expeditions in 1874.

(2) Parts 194, 195, and 196 of the *Proceedings of the Royal Society.*

(3) Vols. II., III., and IV. of the operations of the *Great Trigonometrical Survey of India*, 1879.

(4) Copies of Mr. F. C. Kitto's *Report on the Diamond Mines of Griqualand West.*

For these very acceptable donations, the thanks of the Society to His Excellency were unanimously voted.

Mr Guthrie moved (seconded by Mr H. Bolus) "That Corresponding Members, coming to reside within the prescribed limits, may become Ordinary Members by paying their subscriptions, without further election." This was carried unanimously.

The Rev. G. H. R. Fisk exhibited a specimen of the common Cape Gecko (*Pachydactylus ocellatus* (Cuv.)), which presented the peculiarity of a slender curved tubercular process on the back of the base of the tail.

Mr J. G. Gamble read a paper (illustrated by wall diagrams), on "a Storage Reservoir at Brand Vley, Calvinia Division." In the discussion that ensued, the President, Sir Bartle Frere, the Hon. W. Ayliff, and Messrs Dunn, Guthrie, and Marquard took part.

Dr Theophilus Hahn (who was present as a visitor) read a critique on Mr Hyde Clarke's paper, read at the last meeting, on "The Languages of the Mozambique and of the South of Africa in their relation to the Languages of Australia."

Sir Bartle Frere and Mr Trimen offered some observations on the subject.

The President stated that he hoped to have some future opportunity of more fully explaining the method of determining Time at the Royal Observatory and the means employed for its distribution, and would meanwhile only briefly refer to the circumstances which had recently called public attention to the subject in connection with the time-ball at the Docks. He mentioned that arrangements had been completed for establishing at the Docks a clock in connection with the Observatory, which would shew the actual time whenever consulted, instead of merely giving it at a particular hour in the manner of the time-ball. The time circuit was extending through South Africa with the extension of telegraphic communication, and a time-ball would forthwith be in operation at Pretoria, and in the Transvaal.

Ordinary Monthly Meeting.

WEDNESDAY, November 26, 1879.

MR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Sixteen members and seven visitors present.

Mr Friedrichs of Cape Town, and Dr T. Hahn of Stellenbosch, were balloted for, and declared to be duly elected Ordinary Members of the Society.

The Secretary announced that His Excellency Sir Bartle Frere, the Vice-President, had presented to the Society a Memoir by Dr William Sharpe, entitled, *The Cause of Colour among Races, and the Evolution of Physical Beauty*, published during the current year in London. The thanks of the Society were voted to His Excellency for this donation.

The President intimated that he had received from the Curator of the South-African Museum a communication, dated the 22nd of November, covering a copy of one (with enclosures) from the Hon. the Colonial Secretary on the subject of an application from the Director of the Royal Botanic Gardens at Kew, to be furnished with copies of any printed papers containing Botanical information which may be issued in the Colony. Mr Gill intimated the substance of his reply, and said that he felt sure that the present mention of the matter would enlist the cordial co-operation of Members of the Society—especially of those interested in Botany—in meeting Sir Joseph Hooker's wishes. Mr Trimen observed that he had expressed to the Colonial Secretary his readiness to communicate all matter of the kind which came under his notice, and that he would be glad to receive and forward for transmission to Kew any Botanical papers of interest which Members of the Society might from time to time select for that purpose.

Mr C. Lloyd Morgan read a paper "On the terms Force and Energy." The discussion that ensued was maintained by the President, the Hon. C. Abercrombie Smith, and Mr Guthrie.

Mr Herbert W. Oakley read a paper, "On the Habits of some of the Birds of the Transkei." Mr Trimen, Sir J. H. de Villiers, the Hon. C. Abercrombie Smith, Mr Sivewright, the President, Mr Branford, and Dr Bradshaw took part in the discussion of this paper.

Mr J. Sivewright read a paper, "On the Durability of some Colonial Timbers." The President offered some comments on this communication, and the meeting then adjourned.

Ordinary Monthly Meeting.

WEDNESDAY, January 28, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Seventeen members and nine visitors present.

The donation was announced from His Excellency Sir Bartle Frere, Bart., Vice-President, of the first volume of the *Account of the Operations of the Great Trigonometrical Survey of India*, completing the set of which three volumes were presented by His Excellency in October last. Sir Bartle Frere also forwarded, through the President, three MS. *Army Medical Reports* connected with the recent Galeka and Zulu Campaigns, and suggested that upon examination by Medical Members of the Society they might possibly be found to afford some matter suitable for record by the Society.

Mr Trimen exhibited specimens of *Haplothorax Burchellii*, a rare beetle peculiar to the Island of St Helena, collected by Mr J. Homagee, the Police Magistrate, on the Longwood estate. This fine Carabid constitutes an endemic genus of which it is the sole known species; and it was pointed out as remarkable that its nearest allies in the family *Carabidæ* were, according to Lacordaire, to be met with in Syria. Mr Trimen further remarked on the great peculiarity of the still surviving aboriginal fauna and flora of St Helena, as demonstrated by Hooker, Wollaston, Buchanan-White, Melliss, and others; and pointed out how all the evidence bearing on the subject seemed to indicate the great antiquity of this volcanic island.

Dr B. F. Bradshaw, introduced by the General Secretary, read a paper on "the Tsetse Fly," founded on his own personal observations during several years' travel in the interior of South Africa as far as the Falls of the Zambesi. In the ensuing discussion, the President and Messrs Trimen, Smith, Fry, Gamble, Bindley, Lightfoot, Fisk, Lloyd Morgan, Guthrie, and Kitching took part.

A general discussion followed on the action of animal and other poisons, and on the modes of counteracting their effects. After which the meeting adjourned.

Ordinary Monthly Meeting.

WEDNESDAY, February 25, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Seventeen members and five visitors present.

The following donations were announced, vid.:—

(1) H. E. Sir Bartle Frere, Vice-President:—Printed copy of Capt. H. Wilberforce Clarke's *Report to the Government of India for Guaranteed Railways on the Transporting of Elephants by Railway.*

(2) Lady Frere:—*Ice Chart of the Southern Hemisphere*, issued by the Hydrographic office of the Admiralty in 1874.

(3) Mr Trimen:—Printed paper, *On some hitherto undescribed Butterflies inhabiting Southern Africa*, contributed by him to the Entomological Society of London, and published in that Society's *Transactions* for 1879, Pt. IV.

The thanks of the Society were voted for these donations.

In connection with the paper just mentioned, Mr Trimen exhibited specimens of the ten new species of butterflies therein described, belonging respectively to the genera *Amauris, Debis, Lachnoptera* (previously containing only one species), *Eurema, Junonia, Precis, Neptis, Libythea, Myrina* and *Pieris.*

Mr J. G. Gamble exhibited and shewed the working of a calculating machine of the date 1873, constructed by M. Thomas, of Colmer, and named "L' Arithmomêtre." He also exhibited some photographs illustrating the Port Elizabeth Waterworks, and a new pattern of screw coupling for leaden pipes.

The Hon. J. X. Merriman, M.L.A., read a paper entitled "Some Comparative Statistics relating to South Africa," which dealt principally with the excess of imports over exports as regards the Cape Colony during recent years.

In the ensuing discussion, the President, Messrs Knox, J. W. Ebden, Guthrie, Bolus, Branford, and Canon Lightfoot took part.

Ordinary Monthly Meeting.

WEDNESDAY, March 31, 1880.

MR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Seven members and five visitors present.

Less than ten members being present, the ballot for election of two new members proposed at the last meeting could not (under Rule 5 of the Society) be held.

The donation of the following publications was announced from the Royal Society of New South Wales, vid.:—

Journal of the Royal Society of New South Wales, 1878.

Report of the Council of Education of New South Wales, 1878.

The thanks of the Society were voted for this donation; and it was resolved to forward to the donors a copy of the Society's Transactions as soon as the First Volume should be completed.

Mr W. H. Finlay, of the Royal Observatory, read a paper, entitled "Comets." The discussion that ensued was led by the President, and Messrs C. A. Smith, Guthrie, Gamble, and Trimen took part in it.

Ordinary Monthly Meeting.

WEDNESDAY, April 28, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Twelve members and two visitors present.

Mr F. R. Statham, and Mr G. Mac Keurtan, both of Cape Town, were then balloted for, and declared to be duly elected as Ordinary Members of the Society.

The donation was announced from H. E. Sir Bartle Frere, Vice-President, of

(1) Papers and Plans by Mr W. Parkes, illustrating the Harbour Works in course of construction at Madras.

(2) An extensive series of Works of Reference on Irrigation.

His Excellency's Memoranda on both these donations were read by the President, and the thanks of the Society were unanimously voted to Sir Bartle Frere for this further proof of the interest which he has from the first constantly shewn in the welfare and progress of the Society.

The donation was announced from Dr Emil Holub of a copy of

(1) His paper read before the Royal Geographical Society, on his *Journey through Central South Africa*, and of

(2) Parts I. to IV. of his work, entitled *Sieben Jahre in Süd-Afrika*.

The Society's thanks for this donation were unanimously voted.

A letter, dated 28th April, 1880, was read from Mr E. S. Thomassen, submitting for the Society's inspection printed descriptions and illustrations of Ibbotson Brothers and Company's patent automatic central coupling buffer and patent steel lock link for railway purposes.

The Rev. F. W. Kolbe read a paper, entitled, "On the Primeval Laws of the Vowels and their bearing on Universal Etymology."

In the ensuing discussion, the President, Dr Kitching, and Messrs Fisk, Guthrie, and Morgan took part.

Ordinary Monthly Meeting.

WEDNESDAY, May 26, 1880.

In the absence of the President and Vice-President, the Rev. G. H. R. Fisk was called to the chair.

In the absence of the General Secretary, Mr Bolus was appointed to act as Secretary for the meeting.

Nine members and three visitors present.

The following donations were notified, vid.:—

(1) By His Excellency Sir Bartle Frere:

(*a*) Extract from a private letter from Sir A. Cotton regarding Irrigation and Water Transit in relation to South Africa; and a copy of the same writer's printed *Reply to the Report of the Committee of the House of Commons on Indian Public Works, &c.*,

(*b*) Two printed memoirs by Prof. Owen, C.B., from the Quarterly Journal of the Geological Society for 1876 and 1879, one entitled *Evidences of Theriodonts in Permian Deposits*, and the other *On the Eudothiodont Reptilia, &c.*

(2) By Dr E. Holub:

(*c*) Parts V., VI., VII., and VIII. of his work, *Sieben Jahre in Süd-Afrika.*

The thanks of the Society were voted for these donations; and, after discussion on the subject of the first named, it was agreed to be desirable to ask Sir Bartle Frere's permission to publish the extract from Sir A. Cotton's letter in the Society's Proceedings.

The Rev. W. Fisk exhibited a copy of Sir Joseph Fayrer's fine work *Thanatophidia of India.*

Mr F. Guthrie read a paper on "Free Rigid Rotation." Mr Finlay made some remarks on the subject.

Ordinary Monthly Meeting.

WEDNESDAY, June 23, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Fourteen members and three visitors present.

The Rev. S. Bond, of the Diocesan College, Rondebosch, and Mr W. Tyson, of the South African College, Cape Town, were duly elected Ordinary Members of the Society.

The donation from Dr E. Holub of Parts IX., X., and XI. of his work *Sieben Jahre in Süd-Afrika*, was announced, and the thanks of the Society voted for the same.

Mr Trimen exhibited the horns of a gemsbok (*Oryx gazella*), of which the left horn presented the malformation of being very short and spirally curved like that of a ram, while the other was normal in development and 3 ft. 3½ inches in length.

This specimen, which had been purchased for the Museum, was brought from Walvisch Bay, but its actual habitat in South Africa was not known.

He also exhibited the under-jaw of a remarkable and apparently very rare pigmy Sperm Whale (undoubtedly *Physeter breviceps* of De Blainville, constituted by Gray the type of his genus *Kogia*). Mr Hugo Munro, who had presented this specimen to the Museum, had seen the entire animal stranded on the beach near Knysna, and described it as about seven feet in length.

Mr Trimen also brought before the meeting two specimens of a very singular hymenopterous insect (found near Cape Town by Mr C. A. Fairbridge and Mr L. Péringuey respectively) which he believed to be the long-sought female of *Dorylus helvolus* (Linn.). An example of the male *Dorylus* was exhibited at the same time, as well as three specimens of the small reddish ant in whose nest, at Sea-point, Mr Fairbridge's large female insect was found.

Mr E. W. Young read a paper, "On Surveying with the Omnimeter," illustrating it by exhibiting the instrument itself and by diagrams.

In the ensuing discussion, the President, and Messrs Abercrombie Smith, Guthrie and Fforde took part.

Part III. of the Society's *Transactions and Proceedings*, concluding the First Volume, was on the table, and the Secretary stated that copies of it were in course of transmission to all members.

Ordinary Monthly Meeting.

WEDNESDAY, July 28, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Thirteen members and two visitors present.

The following donations were announced, and the thanks of the Society voted to the donors of the same, vid.:—

(1) His Excellency Sir Bartle Frere:

Prof. M^{c} Coy's *Prodromus of the Palæontology of Victoria.* Decade VI. 1879.

(2) Dr E. Holub:

Parts XII., XIII., and XIV. of his *Sieben Jahre in Süd-Afrika.* And Ritter von Hauer's *Die Geologie,* 1 vol. 8vo., 2nd ed., Wien, 1878.

Mr E. W. Young brought forward the subject of the introduction of trout into South African rivers, and mentioned that an essential preliminary to any action in the matter was to ascertain whether in the three winter months the temperature of the water in suitable streams exceeded 45° Fahr.—the maximum degree stated by Mr Youl to be adapted to the breeding requirements of the fish. The successful introduction of the salmon and trout into Tasmania and Australia was referred to in the discussion on the subject as auguring well for success in the nearly corresponding latitude and climate of South Africa, and it was agreed that the members of the Society would do good service in assisting Mr Young to obtain trustworthy observations of the water temperature in the higher streams during the winter months.

Mr Gamble exhibited a slice of a Sneezewood pile which had been for twenty years under water in the Harbour Works at Port Elizabeth, remarking that the Sneezewood was the only Cape timber that did not suffer from the ravages of *Teredo.* The specimen exhibited was perfectly sound and hard, only an external layer of the sapwood having been perforated by the sea-worm.

Mr C. Lloyd Morgan exhibited fourteen specimens of *Peripatus capensis,* found by him under stones on the slope of Table Mountain near Rondebosch, and remarked on the habits of this singular animal. Mr Trimen gave a short account of the creature's discovery at the Cape, and mentioned the wide range of the genus *Peripatus,* single species being known from isolated localities in the West Indies, South America, and Australia. He also mentioned the valuable researches of Mr H. N. Moseley, whose paper, published by the Royal Society, established the position of *Peripatus* as a tracheated arthropod of a very generalized, and probably very ancient, type.

Mr Herbert W. Oakley read a paper, entitled, "On the Skeleton of the African Darter or Snake-Bird (*Plotus Levaillantii*).

The President, and Messrs Trimen, Gamble, Kitching, Branford and Tyson took part in the discussion that ensued.

Mr C. Lloyd Morgan read a paper, entitled, "Miniature Physical Geology." In the ensuing discussion, the President and Messrs Bolus, Kitching and Trimen took part.

ANNUAL GENERAL MEETING.

FRIDAY, July 30, 1880.

Mr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Sixteen members present.

The General Secretary read the General Report of the Society for the year 1879-80; and Dr Dale (on behalf of the Treasurer) read the Financial Report for the same period. Both Reports were unanimously adopted.

In view of the ballot for election of the President and Council for the ensuing year, Messrs H. Bolus and J. Fforde were appointed Scrutineers.

At the close of the ballot at 3 p.m., the Scrutineers reported the number of votes given, and the President declared the following members to have been duly elected, vid.:

As *President*,—Mr David Gill.

As *Members of the Council*,—Mr F. Guthrie, Mr R. Trimen, Mr H. Bolus, Dr Dale, Sir Bartle Frere, Bart., Mr J. G. Gamble, Mr J. Fforde, Mr H. E. R. Bright, Mr J. Sivewright, and Mr J. X. Merriman.

On the motion of the Rev. G. Fisk, seconded by Dr Kitching, a vote of thanks was unanimously given to the officers of the Society for their services during the past year.

On the motion of the President, seconded by Mr Bright, a vote of thanks to the Mutual Assurance Society for the use of its Hall for the Annual General Meeting was passed unanimously.

At 3 P.M. there was a large attendance of the friends of members, introduced by ticket; and the President soon after proceeded to deliver the Annual Address, which treated of the various modes in which the problem of determining the distance between the Sun and the Earth had been worked out by astronomers, and referred more especially to the speaker's recent observations of Mars, at Ascension, bearing upon the same line of research. A vote of thanks to the President for his most interesting address was moved by his Excellency Sir Bartle Frere, and carried by acclamation.

REPORT ON THE PROCEEDINGS OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY

DURING THE YEAR ENDING JULY 30, 1880.

1. The Council has the pleasure of submitting to the Annual General Meeting the following Report on the Society's operations during the last twelve months.

2. Since the last Annual General Meeting on Wednesday July 30, 1879, eleven Ordinary Monthly Meetings have been held, vid.: one on the last Wednesday of every month but December. The average attendance of Members at the Monthly Meetings has been 12, and that of Visitors 5, making the total attendance of Members and Visitors 17.

3. At the Monthly Meetings seventeen memoirs have been read before the Society, five of which related to Biology, four to Philology, three to Physics, three to Engineering, one to Astronomy, and one to Statistics. Four of these have been printed in the Third Part of the Society's Transactions presently to be noticed. The discussions following the reading of these papers have generally been well sustained and interesting. At the Meetings there have also been frequent exhibitions of Zoological and Botanical specimens, Mechanical and Scientific Apparatus, and Books. Such exhibitions are an important feature of our Meetings, and the Council trusts that the Members will exert themselves to make them as numerous and varied as possible.

4. Important donations of Books have been made to the Society by his Excellency the Right Hon. Sir Bartle Frere, the Vice-President. The most valuable of these are (1) the Reports of the Great Trigonometrical Survey of India, (2) an extensive series of Works on Irrigation, and (3) recent volumes of the Transactions and Proceedings of the Royal Society. Other donors of Books, Maps, or printed papers have been Lady Frere, Dr E. Holub, Mr Trimen, and the Royal Society of New South Wales.

5. During the year there have been elected ten Ordinary and two Corresponding Members. Two Ordinary Members have resigned, and two others have left the Colony. The increase to the Society during the year has therefore been six Ordinary and two Corresponding Members; our numbers at present being 90 Ordinary and 14 Corresponding Members.

6. Owing to representations by the publisher that he would be a serious loser by adhering to the arrangements under which he

had agreed to print and issue the Society's "Transactions," the Council consented to release him from his engagements, and defrayed the printer's charges, taking over the whole issue of 500 copies. As an experiment, they made arrangements to print here a few papers in completion of the First Volume of "Transactions"; and these in the shape of *Part III.*, with the "Proceedings" down to 27th November last, have lately been completed and issued to the Members. So unsatisfactory, however, has the experiment proved, and so great has been the delay involved, that the Council has arrived at the conclusion that economy and despatch would alike be much better insured by having the printing executed in England, and it strongly recommends to the incoming Council the acceptance of the offer of Messrs Macmillan and Co. to print the "Transactions" on the terms stated in their letter dated 24th December last.

7. The Society is again much indebted to the University Council for granting the free use of its Rooms for the Society's Meetings. An office for the lodgement of the Records, Books, etc., has been secured at a small rent on the premises of the Mutual Assurance Society.

8. The Council considers that, on the whole, the Society may be congratulated on what has been done during the past twelve months, and on the position it maintains. As compared with the year preceding, the actual increase of Members has been the same, viz. 8, but of these 6 were Ordinary Members, while the previous year 6 were Corresponding Members. The number of papers read has more than doubled, being seventeen instead of seven only, and at none of the eleven Meetings has a paper been wanting. The average attendance of Members at the Monthly Meetings has only very slightly improved, being 12 in place of 11, but that of Visitors has risen from 2 to 5. In a body so young as our own, it is something to have tided over the discouragement (due to special circumstances) of the second year of our existence, and to be able to point to signs of renewed vitality and progress. At the same time we are bound to admit and to bear in mind that it is still the day of small things with us thus far; and that much more active interest in our work must be shewn by the Members generally, if we are duly to carry out the high purposes for which the Society was enrolled.

9. The financial condition of the Society is very satisfactory, as will more fully appear from the Report of the Treasurer which will now be read to the Meeting.

By Order of the Council,

R. TRIMEN,

General Secretary.

THE TREASURER IN ACCOUNT WITH THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

Dr. 1879	£.	s.	d.
To Balance in Standard Bank	276	3	6
To Subscriptions received, 82 members	164	0	0
	440	3	6

1879 Cr.	£.	s.	d.
By Advertising, Printing and Stationery, sundry payments	12	16	10
By expenses, Dr Holub's lecture	3	7	0
By expenses, printing Transactions	94	3	9
By charges, attendance and petties	5	15	2
By Fees on collection of subscriptions	3	9	0
By Fixed Deposit account deposited in Standard Bank	200	0	0
By Refreshments at Monthly Meetings	10	4	0
By Clerical assistance to Secretary	20	0	0
By Balance in Standard Bank	90	7	9
	440	3	6

CAPE TOWN, *July* 20, 1880.

HARRY BOLUS, *Treasurer.*

We the undersigned members of the South African Philosophical Society do hereby certify that we have examined the above account, compared the cash payments with the vouchers and the balance with the Bank Pass Book, and find the same to be correct.

W. A. LIPPERT
J. HORAK DE VILLIERS } *Auditors.*

ANNUAL ADDRESS TO THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY,

DELIVERED ON JULY 30, 1880.

Rule 18 of the Society provides that "At the Annual Meeting the President of the past year, or, at his request, some other person to be nominated by the Council of that year, shall deliver an address on some subject connected, as far as possible, with the objects of the Society." And concerning these objects, Rule 2 states that they shall be "To promote original research and record its results, especially as connected with the Natural History, Physical Condition, History, Geography, Statistics, Industrial Resources, Languages, and Traditions of South Africa."

In accepting the chair which I have now the honour to occupy, I expressly stipulated that this rule should bear a very wide interpretation. The percentage of men naturally fitted for research is small, and of these not a few are prevented by business and other causes from following their natural bent. Here in South Africa, where superfluous energy after business labour is, I regret to say, not by any means abundant, and where the actual number of possible workers in original research is also very limited, I think it behoves us not to be too strict in limiting our field, but that we should accept thankfully all original contributions to science. And not only so, but I think we assume too much if we reject all contributions that are not original. I hold that it should be the duty of this Society to require from its members from time to time communications which are not strictly on original research, but which bear on our present state of knowledge of particular subjects. Such papers are of the greatest value for reference, and afford, perhaps, the best mode of reaching the outside world in our work, and of gathering in, by awakened interest, fresh labourers in the field of original research.

It is not my intention in the following address to refer more particularly to the work of the Society during the past year. You have done me the honour to re-elect me as your President for another year, and I propose to follow the example of my illustrious predecessor, His Excellency Sir Bartle Frere, and to defer a review of the work of the Society until the close of my two years of office. Nor shall I attempt to indicate the objects of research specially open to members of the Society. I feel that in his exhaustive address, now printed and in the hands of members, His Excellency

has pointed out these objects with a breadth and a grasp that are beyond the powers of a poor specialist like myself.

To-day I propose rather to vindicate my own past silence at the evening meetings of the Society, by a short account of some investigations in which I have been engaged, and I also propose to apply the conditions of interpretation of Rule 2 to which I have referred, by offering as my address the previous history of a scientific problem which is not peculiarly South African.

My own researches for the past three years have been occupied in the determination, or rather in *a* determination of the distance of the Earth from the Sun.

I propose in the present address to give the results of this investigation, and, by way of introduction, to explain the various methods by which the distance of the Earth from the Sun has actually been determined, and what have been the various results of the so doing. I shall try, in fact, to show how it is possible to apply the standard yard of England, kept in a box in the House of Commons, to the actual measurement of the Sun's distance.

The first step of a surveyor who wishes to determine the area of a tract of country is to measure a base-line. An ordinary surveyor uses a chain of which he knows (or ought to know) the true length; but in more exact surveys compensation bars are employed; that is, an apparatus arranged so that, whatever the temperature, the length remains constant. Or he uses steel or platinum bars provided with thermometers to determine their temperature, the true length of each bar being determined for each temperature.

Such a base-line was measured by Sir Thomas Maclear in Zwartland. The operation occupied five months, the length of the base-line was about eight miles, and the probable error of its whole length was four-tenths of an inch.

Now, these compensation bars, used by Sir Thomas Maclear, were compared frequently during the operation of measuring the base with two standard bars which had been sent out from England. These bars (now in my custody at the Royal Observatory) had in turn been rigidly compared with the standard yard of England, or with copies of that yard, whose errors, in terms of that yard, were rigidly known. Thus the length of Sir T. Maclear's base became known in terms of the standard yard of England.

The next step was to extend this base over a large area of country, and this was done by the ordinary operations of triangulation, the sides being gradually expanded till they attained a length of from forty to eighty miles—and so afterwards, extending the operation by leaps of forty to eighty miles, till the actual distance was determined between Cape Point and a station on Bushman's Flat, near the Orange River.

So far then we see how the distance between two points on the earth's surface is measured in terms of the standard yard. The next step must be to find out what proportion this part of the earth's circumference bears to the whole of the earth's circumference.

This is done very easily. We have only to take a very perfect theodolite or similar instrument, and measure, by its means, the altitude of any particular star as it passes the meridian first at one of the places and then at the other. The difference of the two altitudes will be the difference of the latitudes of the places. Now, Sir Thomas Maclear wisely selected places in the same meridian, and he found, for example, that two of his stations differed 3·6 degrees in latitude (in round numbers), or in other words they were one-hundredth part of the whole circumference of the earth apart. Therefore, if the earth was quite round, one hundred times the measured distance between those stations would be the circumference of the earth.

All the information we obtain, however, from Sir T. Maclear's arc, is the length of a degree at the earth's surface in this latitude. But other arcs have been measured in England, France, Germany, Russia, India, Peru, &c., and these give the length of a degree in their respective latitudes. If the earth were round, the length of a degree as determined in all these different latitudes would be the same. This is not found to be the case, but a combination of all these results shows that the earth's true form is nearly an ellipsoid, which is precisely the form it would assume according to the theory of gravitation if it were a plastic ball spun round upon an axis at the same rate as that at which the earth revolves. Now the standard base-bars employed in all these measures of the earth have all been compared more or less directly with the standard yard of England, and thus the form and dimensions of the earth are accurately known in terms of the standard yard. In this way we can employ the earth as a great base line. We have, in fact, established a new base line about 1,000 times as long as Sir T. Maclear's base in Zwartland; and now how are we to use it to determine the sun's distance from the earth?

The sun's distance we know is something between ninety and ninety-five millions of miles, but this is a terrible distance to measure with a base line so short as 8,000 miles—the earth's diameter.

Let us realize the position. Suppose it were even possible to place observers on exactly opposite points of the earth's surface, they would have what surveyors call a very ill-conditioned triangle to deal with. The general principle is that the smaller the base in proportion to the distance, the more difficult does the determination of the distance become. What would an ordinary surveyor say if you told him to determine the exact distance of a church spire

twelve miles off, and limited him to a circular plot of ground feet in diameter, telling him that he may place his theodolite he likes, and in as many places as he likes, and he may set many signals as he pleases all within this plot of ground, bu out of this plot of ground he must not go, and yet that he determine the distance of the church to a hundred yards observations on this plot of ground alone. The surveyor probably decline to entertain any such idea, and would pron the whole thing impossible, and *yet he would have an easier than the astronomer who sets himself to determine, with a base to the earth's diameter, the distance of the sun to half a milli miles.*

Here then it is perhaps well to consider why it is worth to tackle so difficult a problem, and what importance or bearing has this question on the progress of science; in what shall we be bettered by knowing whether the sun's distan nearer to ninety or ninety-five millions of miles. That the que does interest the minds of men is proved by history, both an and modern. Aristarchus, Ptolemy, Hipparchus, Tycho B and Kepler, have laboured to solve it, and the general int excited by the transit of Venus in 1874 proves that the que still occupies the mind of men. But to the astronomer determination of the sun's distance is the determination c standard of measure. It is the fixing of a base line outsid earth, by which he can measure the dimensions of the Solar Sy and then reaching thence, proceed to the determination o distances of other suns—the fixed stars; and it is the only m by which he can hope to arrive at even faint crude guesses o vastness of creation, and the glory of the Creator. The solutio the problem of the sun's distance also plays an important par the calculation of the mutual perturbations of the moon planets, and therefore on the predictions of the *Nautical Alma* by aid of which our fleets navigate the trackless seas.

The accurate determination of the sun's distance has therefore become one of the most pressing wants in Astronomy, and Sir George Airy, the present Astronomer Royal of England, has well described it as "the noblest problem in astronomy." Here then are grounds enough, apart from the abstract argument which is perhaps the best of all, that truth for truth's sake is the noblest incentive to study.

The first attempt to measure the sun's distance was made by Aristarchus of Samos, about 300 B.C., and he tried the following ingenious plan:—When the moon is half full, the angle *SME* must be a right angle. If then the observer can seize the precise time when the moon is exactly half full, and at that precise time measure the angle *SEM* (the angle at the earth between the sun

, the thing is done,—that is, we find the distance of the
ms of the distance of the moon, because we know one
vo angles in the triangle *SME*. In this way Aristarchus
the sun's distance to be twenty times that of the moon's
arth, a result we now know to be nearly twenty times
The practical difficulties were that from the roughness
on's surface it is impossible to say precisely when the
alf full; and secondly, the real angle *SEM* differs so
a right angle that without more defined means than that
ted in the days of Aristarchus, the difference of the angle
1 90° could not be accurately measured.
evice of employing the proportion of the moon's distance
the sun has been employed by subsequent astronomers,
rn astronomers have also resorted to other means of
better conditional triangle. Though astronomers cannot
he size of the earth or rig out long poles projecting some
of miles from the earth's surface, from the ends of which
their observations; there remains an equivalent plan of
the base, or rather of getting a better conditioned
wherewith to measure the sun's distance, viz., to select
objects not so far distant from the earth as the sun. Thus
et Mars, in certain circumstances, approaches within one-
the earth's distance from the sun, and the planet Venus
one-fourth of the same. Now when the angle to be
l is very small, it is nine times as easy to measure a
three times as near, or sixteen times as easy to measure
times as near, and so on,—the law varying *cæteris paribus*
square of the distance. Hence, all other conditions being
, it will be nine times easier to measure the distance of
sixteen times easier to measure the distance of Venus, than
be to measure the distance of the sun.

But you will naturally ask, Of what use is it to measure the distance of Mars or the distance of Venus—what has that to do with measuring the distance of the sun?

The answer is that the proportional distances of all the planets are perfectly known. We can, in fact, make for any instant a very perfect map of the positions of the planets and the sun, but the *scale* of the map we cannot give with any approach to a like accuracy. About the year 1620 Kepler made his great discovery of the laws of planetary motion, one of which says:—"The squares of the times of the revolutions of the planets are proportional to the cubes of their mean distances from the sun." That is to say, there is a fixed relation between the mean distances of the planets from the sun and the times of their revolutions—or, in other words, we know the proportional distances of all the planets belonging to the solar system, so that if we can only determine one of those distances we

know them all. This law of Kepler's was deduced from observation, but was afterwards shown by Newton to be a necessary consequence of the law of gravitation. There is no doubt whatever about this law, and, indeed, the proportional distances of the planets were nearly as well known in the days of Kepler as they are now. What was then wanting, and what is still desired with higher and higher precision, is a determination of any one interplanetary distance with an extreme accuracy.

Now, in the first place, let us take the case of Venus. When it happens that the earth and Venus come both together to the line of intersection of their orbits, then the earth, Venus, and the sun are in the same straight line, and what is called a transit of Venus occurs. Venus, as a round black disc, appears to enter upon the disc of the sun, passes across it, and disappears. Venus appears black because the source of its illumination is the sun, and the sunlight, coming from the further side of Venus only, does not illuminate the side near to us. In fact, a transit of Venus is similar to an eclipse of the sun by the moon, only Venus is very small compared with the moon.

There will be a Transit of Venus in the year 1882. The first internal contact, as shown in the drawing, that is, the time when the edges of Venus and the sun will be in contact, occurs here at about twenty-six minutes past three o'clock, local time, on the afternoon of December 6, 1882, and the sun will have set before Venus has passed off the disc. But this contact will not happen at the same time in all parts of the earth. If any one will look at the disc which I hold in my hand, and note where it is projected upon the large disc behind, and then move his head from side to side, he will see that the small disc appears to move with respect to the larger disc. Or, if I move the small disc slowly across the face of the larger disc, all the persons in the room will not see the apparent contacts of the edges of the two discs at the same instant, because the two discs are at different distances from the observer's eye. This displacement is called parallax, and the sun's horizonal parallax is the amount that the sun is displaced when looked at on the horizon instead of the zenith. Now this displacement is just what will occur on the occasion of the Transit of 1882. Venus will be about four times nearer to the earth than the sun, and so astronomers will be able to observe a displacement or parallax equal to the difference between the parallax of Venus and that of the sun, and the internal contact will take place about ten minutes earlier as seen from the Cape of Good Hope than as seen from London. The actual difference of these times, if the contacts have been accurately observed, enables the astronomer to calculate how much Venus was displaced by being viewed from two different points, for he knows accurately the relative angular motions of

Venus and the sun in a given time as well as the proportional distances. Thus with his knowledge of the dimensions of the earth, which gives him the distance and direction of the line joining London and the Cape, he is enabled to compute the distance of Venus and also that of the sun.

So far the method is very simple and very beautiful. No instruments except a good clock and a good telescope are required, and some means of determining local time, provided that the latitude and longitude of the observing stations are known. Astronomers are well accustomed to note phenomena to the tenth part of a second of time, and if the contact could be noted with the certainty of even half a second, the sun's distance would be determined by one observer at the Cape and by one observer in London within less than 100,000 miles, an accuracy sufficient in the present state of science.

This method of observation was first proposed by England's astronomer, Halley, in 1716, when he was an old man, and he pointed out that the transits of Venus of 1761 and 1769, which he could not hope to see, afforded the best means of determining the sun's distance. Both transits were observed, the former not satisfactorily, but the latter with much care, expeditions having been sent to different parts of the world for this purpose.

It is not my object or intention to-day to enter into detailed accounts of these expeditions. It is enough to state that the results were not found to be so satisfactory as was expected. It is true enough that astronomers can very easily note the occurrence of a phenomenon to half a second and much less, provided that the phenomenon itself is precise and instantaneous. But a transit of Venus contact has been found to be by no means of this character. What observers really saw was a gradual approach of two limbs, a gradual shading or softening of these two limbs into each other, but nothing that was sharp, precise, or definite, or that could be noted to half a second of time. Indeed the event proved that, as a rule, those observers who pretended to an extreme accuracy of their observation were ultimately shown to have made the worst observations. Thus the observers could find no precise phenomena to note, but had to state, *at this time* I saw such an appearance—*at this time* such another appearance—*at this time* a third appearance; and so on. But the greatest difficulty of all arose when these different observations had to be combined, when corresponding phases at opposite stations had to be selected, because what the calculator had to do was simply to find when two observers noted the same phenomenon from opposite sides of the earth. It is no matter whether a real or unreal contact was observed, it is only necessary to be certain that the two opposite observers noted the same phenomenon.

The same phenomenon would correspond with the same apparent relative angular distance of centres of the sun and Venus, and the difference of time of their arriving at this same relative distance enables the astronomer to calculate the angle of displacement, and hence the distance of Venus and that of the sun. But the real difficulty, as I have stated, is to be sure that corresponding phases have been selected. It is precisely upon this point that astronomers have not agreed. The observers at different stations use such different language to express what they saw, that it really is difficult, if not impossible, to select corresponding phases from the observations. Thus from the transit of Venus in 1769, Encke, one of the most celebrated astronomers of his time, deduced for the sun's distance 95·0 millions of miles, a result which was accepted without question by astronomers for thirty years, whilst in 1868 Mr. Stone, my esteemed predecessor, rediscussed the same observations and deduced from them 91·7 millions of miles. This great difference arose from no mistake whatever in the calculations of the two astronomers; the whole question turned upon the interpretation to be put upon the language of the observers.

Again in the Transit of 1874, the original discussion of the British observations by Sir George Airy gave 93·4 millions of miles. Whilst Mr. Stone, rediscussing the same observations, obtained 91·2 millions of miles.

This is neither the time nor place to enter upon a discussion of the relative merits of these interpretations—nor indeed do I think it will ever be possible to arrive at such an interpretation of the language of all the observers as will be satisfactory to the minds of all competent judges. My contention rather is that a method which involves a matter of opinion in the interpretation of an observer's language—that is a method which permits two or more conclusions to be derived from the *same* observations, is not suitable for use in so delicate an investigation.

I believe it may not be impossible, with the experience we had of the last transit, and by the employment only of skilful and experienced observers, whose attention is to be directed to one special phenomenon or appearance, and with instructions to wait for and note that appearance and that only, that a valuable result may be obtained from the transit of 1882.

There is another method which has been employed to determine the sun's distance, which is not quite so easy of popular explanation. It depends, like the method of Aristarchus, on the proportion which the moon's distance from the earth bears to that of the sun. The moon is so comparatively near, that by observing it from the Cape of Good Hope and Greenwich, we get a sufficiently accurate determination of the distance. The moon, if it were not attracted by the sun and planets, would move round the earth in an elliptical

orbit. But the sun and planets pull the moon about very much and render the calculation of her exact path the most complicated and elaborate problem in Astronomy. Amongst the terms by which these perturbations are expressed is one called the *parallactic inequality*, which depends on the proportion between the parallax of the sun and that of the moon—in other words, on the proportion of their average distance from the earth. From the mathematical theory of the moon's motion, we obtain the proportion which the constant of this term bears to the sun's parallax, so that, if this constant can be determined from observation, the sun's parallax, that is the sun's distance, becomes known.

This appears at first sight to furnish a very accurate method, because an error of one second of arc in the determination of the *parallactic inequality* will produce an error of only one-fourteenth of a second in the solar parallax, corresponding to about 700,000 miles in the distance of the sun. But the accurate determination of the constant is combined with an unfortunate difficulty, viz., that observations for the *parallactic inequality* have to be made when the moon is near first and near last quarter—in other words, when opposite limbs of the moon have to be observed. Therefore, all the uncertainty of the measurement of the moon's diameter enters into the result. Now the determination of the diameter of the moon is a most difficult matter, because the moon is never perfectly full, except at the time of a total eclipse of the moon, and its apparent diameter is also different according to the optical qualities and dimensions of the telescope employed, and according to the darkness of the back-ground of the sky. This is due to what is called irradiation, and it can be most readily understood by an illustration. If you punch two equal holes in a piece of card, and place the card at some distance in a darkened room, and then illuminate both holes by placing a bull's-eye lantern behind the card, of course you will see two equal bright discs. But if now a slip of oiled paper is interposed behind one of the holes so as materially to reduce the illumination of one of the discs, the brighter disc will appear the bigger.

Or to take another illustration. In this beautiful sky, before first quarter, we have all observed the bright crescent of the moon, and at the same time the much less brilliantly illuminated portion—what, in fact, is commonly known as the old moon in the new moon's arms. The crescent is the portion of the moon illuminated by direct sun-light, the other part of the moon is illuminated only by earth-shine, that is by sun-light reflected from the earth, for when we have new moon the earth is full to the moon. Watching the beautiful *spectacle* more attentively, we see that the part which is brightly illuminated seems to have a bigger diameter than the dark

part, and the darker the back-ground of the sky the greater is the difference. Employ now an opera-glass, and you will still see the brighter limb beyond the fainter limb, but not so much beyond it as with the naked eye; a small telescope will show less difference still between the two diameters, and in a very powerful and perfect telescope the difference will nearly disappear.

Thus irradiation and its variations prevent our ever getting an accurate determination of the moon's diameter. All that we can hope to do is to assume that for the same observer and the same telescope, under the same circumstances of illumination, the apparent diameter of the moon will be the same—then from the observations themselves we must try to find out the correction of the assumed diameter.

The necessity for so doing diminishes very greatly the value of the method, and indeed it is very doubtful if the method is one that is capable of the highest precision. It becomes necessary, in fact, to make certain assumptions, and upon what these assumptions are will the result more or less depend.

The lunar theory too, as I have already said, is one of the most complicated and intricate problems of mathematical astronomy. From the nature of the problem, at least in the present state of mathematics, there is no step in it which is definite or complete. Each step is gained by a series of approximations, and each approximation affects the other steps, introducing approximation upon approximation. The problem has taxed the powers of the most eminent mathematicians since the days of Newton, and there still remain small discordances between prediction and observation which the best theories do not satisfy. Quite recently one of these systematic discordances was pointed out by the well-known American astronomer, Simon Newcomb, and he found means of computing this error sufficiently well to enable us to calculate the errors of the Tables of the Moon for some time to come, so as to satisfy observation very accurately. But this correction was so far unsatisfactory that he could perceive no sufficient theoretical grounds for the correction which he provided.

About the same time a young English astronomer, Mr. Neison, discovered, from theoretical considerations, some new inequalities resulting from perturbations caused by the attraction of Jupiter. Still more recently Mr Neison announces the discovery of two other theoretical inequalities, and he has discussed the effects of these and finds that their introduction materially affects the resulting value of the parallactic inequality, and hence the deduced value of the sun's distance.

I shall not encumber your minds with figures at present, but

at a future stage of my address shall endeavour to place all the results together in clear and intelligible order.

Now we come to another means of determinating the distance of the sun. Light does not travel with an infinite velocity, but at the rate of about 186,000 miles per second. In the year 1675 Roemer found in observing the eclipses of Jupiter's satellites that when the earth was on the side of the sun nearest to Jupiter, that the eclipses of the satellites occurred on the average before their predicted time, and when the earth was on the farther side of the sun from Jupiter, they occurred behind the predicted time. His ingenious conclusion was that light took a sensible time to travel, and that in consequence a phenomenon occurring at Jupiter would be seen sooner when the earth is nearest Jupiter than when on the further side of the sun from Jupiter.

By the aid of this discovery, and by the successive labours of Cassini, the two Maraldis, Newton, Euler, and Laplace, Delambre was at length provided with a mathematical theory of the movements of the satellites which he could compare with observation, and in so doing he was able to determine what is briefly called the *light equation*, that is, the time which light takes to traverse the mean distance of the earth from the sun. He found that the time required by light to traverse the distance of the earth from the sun—that is, the *light equation*—to be 493·2 seconds. If, then, we only find out independently the number of miles which light travels in one second of time, the simple multiplication of this number by the *light equation* gives us the sun's distance in miles.

But the direct determination of the velocity of light is a most difficult problem, and it would exceed the limits of the time at my disposal, were I to attempt now to describe the methods by which these difficulties have been overcome. Perhaps at some future time I may return to this subject; meanwhile it is sufficient to state that Foucault, the eminent French physicist, was the first to make such a determination, and he obtained 185,200 miles per second for the velocity of light. Fizeau, another French physicist, by a different method, found a somewhat similar result.

More recently, M. Cornu, employing more refined apparatus on the principle of Fizeau, obtained 186,400 miles per second. And last of all, Master Michelson, of the United States Navy, employing a method of observation very similar to Foucault's, but with infinitely more powerful and accurate apparatus, obtained the same result of 186,300 miles per second, which seems to be certainly accurate within 100 miles.

But now that a very accurate determination of the velocity of light has been obtained, the question arises, Is Delambre's value of the *light equation* beyond dispute? Delambre had only at his

disposal old observations of the eclipses of Jupiter's satellites made between 1662 and 1802, with the inferior telescopes and doubtful absolute time determinations of that period. It occurred to a young Russian astronomer named Glasenapp that it might be well to re-discuss the question, employing only modern observations of the eclipses of the first satellite between the years 1848 and 1873. The result of Mr Glasenapp's discussion is to find that the constant of the *light equation* instead of 493·2 is 500·8, and the probable error of this result is about one second. I shall show presently how this affects our estimate of the earth's distance from the sun.

But there is still another method by which we can apply the determination of the velocity of light to our problem. It is more difficult to explain this method popularly, but I shall try. Suppose that a man holds up an umbrella to protect himself from a shower of rain. Suppose, also, there is no wind, and that in consequence the rain falls vertically. If the man stands quite still the apparent course of the rain will also be vertical, and the man will be perfectly sheltered by his umbrella. But what will happen if the man begins to move rapidly forward? Let us suppose for convenience that the distance of the stick of the umbrella from the edge is the same as the length of the handle below the edge. Suppose also that the man holding the handle of the umbrella is seated in an open carriage which is moved horizontally forward with the same velocity as that at which the rain is falling; let us see what will happen. Why this: The drop which left the edge of the umbrella will take the same time to fall the length of the stick of the umbrella as the hand of the man will take to be transported by the motion of the carriage through the distance between the stick and the edge of the cover; therefore the drop which left the umbrella will just fall on the man's hand at the bottom of the handle. Or, in other words, the *apparent* direction of the rain will be changed, and to get the full protection of the umbrella the man must incline the umbrella forward through an angle of 45 degrees. In fact, if the night were so dark that the man could not see surrounding objects, and if the carriage was moving over a perfectly smooth surface, the man could not tell whether the rain was really falling vertically and he being moved rapidly forward, or whether the carriage was at rest and the rain blowing in his face. But if the man knew that the carriage was being moved for ten minutes at a certain rate in one direction, then stopped and moved at the same rate in the opposite direction, if he found in these circumstances that the umbrella had to be inclined equally in opposite directions in order to afford him the best possible shelter, then he would know that the true direction

of the rain was vertical. Or, on the other hand, if he found, when moving east, that the umbrella had to be very much inclined, and when going west only slightly inclined, then he would know that in reality the wind blew the rain from the east. Moreover, if he had some very accurate plan of measuring the inclination of his umbrella—for example, if the handle was a tube, open at both ends, and he could so place it that the rain-drops would fall directly down the tube without touching the sides, and if he had accurate means of measuring the inclination of this tube, he could determine the relative velocity of his motion to that of the rain. For he would only have to make a drawing. Lay down AB for the tube, inclined at the measured angle to the horizontal line AC, draw BC perpendicular to AC, then BC will be proportional to the velocity of the rain, and AC proportional to the velocity of his motion. Now let us substitute the earth travelling in its orbit round the sun for the imaginary smooth carriage, and also the waves of light coming from distant stars for the rain, and the telescope and micrometer of the astronomer for the hollow stick of the umbrella,—and what results? Why this, that just as the *apparent* direction of the rain-drops appeared to change when the man travelled in opposite directions, so to the astronomer does the apparent direction of the stars change according to the direction in which the earth is travelling, for during six months in the year the earth from its motion round the sun must be travelling more or less towards a star, and in the remaining six months more or less from it. Of course the changes in the apparent place of a star are very small, because the velocity of light is very great compared even with the velocity of the earth in its motion round the sun. Still, small as it is, the displacement is very measurable by the refined methods of the astronomer.

The great Russian astronomer, Wilhelm Struve, by one of the most elegant and refined series of observations ever made, has found that the angle CBA is 20·445 seconds of arc. This angle is called the *constant of aberration*, and means the largest amount that a star can be displaced by the causes I have described. The sine of this angle is the ratio of the velocity of the earth's motion to the velocity of light; hence, the velocity of light is 10,090 times the average velocity of the earth's motion round the sun.

If Struve's result be absolutely correct, we know the exact proportion between the velocity of light and the mean velocity of the earth's motion round the sun. Hence, if we determine the number of miles at which light travels in a second, we know from Struve's investigation the number of miles which the earth travels in a second, and knowing how many seconds the earth takes to revolve round the sun we know the circumference of the earth's

orbit, and thence its radius, which is the sun's distance from the earth.

Bradley was the first to trace this shifting of the apparent places of the stars to its true cause, and from his observations he deduced for the *constant of aberration* 20·25 seconds of arc. But later astronomers have deduced slightly greater values.

Lindenau from the R.A. of the Pole Star	20·45 secs.
Peters „ „	20·43 „
Lundhal from Declinations of the Pole Star	20·55 „
Peters „ „	20·50 „
Struve	20·445

Of all these determinations Struve's is the most reliable, and indeed it does not differ in any sensible degree from the mean of the others.

But there is another method to which I must now refer, and it is very easy of explanation. It is evident that when an opposition of Mars occurs when Mars is in aphelion (that is, in that part of its orbit furthest from the sun) and when the earth is at the same time in perihelion (*i.e.*, in that part of its orbit nearest to the sun), Mars will be far removed from the earth; and, on the other hand, if an opposition occurs when Mars is near perihelion and the earth in aphelion, then Mars will approach near to the earth. It is, of course, these oppositions, in which the latter conditions are most nearly realized, that are favourable for parallax determination. It is then only necessary to observe the angle between Mars and a neighbouring star at two different observatories, and the thing is done; the difference of the angle from direct measurement at the two observatories, and the known relative distance and position of the two observatories, permitting the distance of Mars to be calculated. From this method results varying from ninety to ninety-five millions of miles have been obtained at various times. That obtained from the favourable opposition of 1862, by Mr Stone, from the Greenwich, Pulkowa, and Washington observations in the northern hemisphere, and those made at the Cape of Good Hope and Melbourne in the southern hemisphere, being 91·7 millions of miles; and Professor Simon Newcomb, discussing the same series of observations, but including the results of other Observatories not included by Mr Stone (some of which Mr Stone did not consider satisfactory), obtained 92·2 millions of miles. But the method of observation does not admit the most extreme accuracy—at least, extreme accuracy has never been obtained by the ordinary methods of meridian observation. Mars is a very difficult object to observe,—very brilliant and very large

he looks in the telescope, and his limbs or edges are fringed by coloured light when he is observed at a low altitude, because the earth's atmosphere acts like a prism colouring his lower limb red, and his upper limb violet. Now red is a much more staring or well-marked colour than violet, especially when viewed in the field of a telescope illuminated by white light, for it is necessary to illuminate the field of a telescope in order to view the spider webs with which the observations are made—and thus the observer has a tendency to cut with his spider web more deeply into the feeble violet limb than into the more glaring red limb. The effect of his so doing is to make the distance which results from the observations smaller than the truth. At least this I believe to be the reason why observations by this method have given a larger parallax—that is, a lesser distance—of the sun (as a rule) than other methods.

There is another method which deserves to rank amongst the exact methods of determining the sun's distance. It is due to the distinguished astronomer, Leverrier. It depends upon the variations which are produced from year to year, and century to century, upon the elements of the orbits of the planets by the attraction of the earth. It has this great advantage, that if the planetary theories are mathematically perfect, these secular variations go on increasing from year to year, giving a determination always increasing in accuracy. Unfortunately the mathematical processes from which the result must be evolved are so intricate and laborious, that there is the greatest risk of some steps being overlooked. Indeed, it almost appears as if this were the case, for Leverrier's tables of the planets Mars and Venus already show such discrepancies between theory and observation as could not occur if these theories were as complete as they were supposed to be by their illustrious author.

The results obtained by Leverrier by his method are:—From the motions of Mars, 92·2 millions of miles; from the motions of Venus, 92·3 millions of miles. For the reasons I have stated, however, there now appears to be some doubt attaching to the previously supposed extreme precision of these results.

To obviate the difficulty caused by the disc of Mars in observation, Dr. Galle, of Breslau, proposed to employ, instead of Mars, some of those minor planets whose orbits lie between Mars and Jupiter. Of course these planets never approach the earth so near as Mars, and only a few of them come nearer to the earth at opposition than the sun's mean distance. But Dr. Galle argued, and I think with good reason, that though they were not so near as Mars, being minute points, indistinguishable by their discs from stars, they afforded objects capable of more accurate observation,

and that the increased accuracy of the observations would more than compensate for the small angle to be measured. A series of observations was made on the planet Flora in the year 1874, by the method originally proposed by Dr. Galle, in which a considerable number of Observatories in both hemispheres took part. But the instrumental equipment, especially in the southern hemisphere, was not adequate for the refined observation necessary. Still the results, though not very accordant *inter se*, showed the capabilities of the method sufficiently to encourage further trial with more adequate means, and gave for the sun's distance 92·1 millions of miles, a result sufficiently in accord with the then received value. This is a future field of work in which I yet hope to see the Royal Observatory here do good service, when an equatorial telescope has been provided worthy of the traditions of the Observatory and the beautiful skies under which it is placed.

But there is another method of determining the sun's distance which had not yet got a fair trial. It was proposed by Sir George Airy in 1857, and consisted in utilizing the rotation of the earth as the means of viewing the planet Mars from two different points, instead of employing two observers at different points of the earth's surface. An observer was to occupy a station near the Equator, make observations of the interval in time between the passage of Mars and of a star over the webs in the field of the telescope soon after sunset in the evening, when Mars is rising in the east, then wait till the early morning and observe again the interval between the passage of Mars and the same star. During the interval between these observations the observer would be transported some 6,000 or 7,000 miles by the rotation of the earth alone. It would be thus possible for the same observer to view Mars from opposite sides of the earth, and there seems a greater probability that the observations would thus be made in a similar manner than if two different observers were employed.

In 1874, when preparing for the observation of the Transit of Venus in that year, it occurred to me that this idea of Airy's might be utilized in connection with Dr. Galle's suggestion of employing the minor planets, to which I have already referred. I had also been experimenting with an improved construction of an old instrument called the heliometer, and I found that it afforded the means of measuring the angular distance between two neighbouring celestial objects with an accuracy far better than could be attained by the method of transits. I therefore proposed to observe, by means of the heliometer, the angular distance between the minor planet Juno and a neighbouring star in the evening and early morning. The difference of the tabular error of Juno as deduced from the evening and morning observations would give the means

of computing the planet's distance from the earth, and thence the distance of the earth from the sun.

Lord Lindsay's yacht, which conveyed the heliometer to Mauritius, unfortunately did not reach her destination till the most favourable time for making the observations was past, but enough of time still remained to test the goodness of the method. The result of the observations went to show that this plan was probably capable in the end of determining the sun's distance with a higher accuracy than any other, and it had the advantage that almost every year some minor planet or other was favourably situated for such observations.

The sun's distance resulting from the few observations of Juno made at Mauritius was

93 3-10ths millions of miles, or rejecting one discordant night's work,
92 8-10ths millions of miles.

It would have required a far greater number of observations to give this result much weight; the chief value of the series of observations was to show the accuracy of the method by the agreement of the results of the different nights' work with each other.

In August and September, 1877, there occurred the most favourable opposition of Mars during the present century. Mars was then very near perihelion, and the earth near aphelion, and Mars was distant from the earth only about one-third of the distance of the sun. I suggested to the Royal Astronomical Society that this was an opportunity not to be neglected. I proposed to employ the method of observation which I had used in the case of Juno, and requested and obtained the co-operation of the principal Observatories of the world in determining the places of the stars of comparison.

With the aid of a vote of money from the Society, and the loan of a fine heliometer (which I used in Mauritius) from Lord Lindsay, I organized an expedition to the island of Ascension, and there made the proposed observations. I returned to England in the beginning of 1878, and most of my spare time since has been occupied in the reduction of the observations. The results, I am happy to say, are now in the hands of the Royal Astronomical Society ready for printing, and the experiment appears to have been successful.

In the following table are given the results of each evening's and morning's work, and it will be observed that the results from individual pairs of independent evening and morning observations do not differ so much from each other as do the results which have been derived by different astronomers from the *same* series of transit of Venus observations:—

Separate results of distance of the Sun derived from observations of Mars at Ascension :—

Morning.	Evening.	Resulting Parallax. Secs. of arc.	Corresponding Sun's distance in Millions of miles.	Weight.
	July 31	8·90	91·8	·113
	Aug. 5	8·65	94·5	·086
Aug. 12	Aug. 10...	8·80	92·9	·175
Aug. 14	Aug. 13...	8·83	92·6	·180
	Aug. 15	8·80	92·9	·079
	Aug. 16	8·90	91·8	·091
	Aug. 19	8·88	92·0	·109
	Aug. 24	8·77	93·2	·227
	Aug. 29	8·84	92·5	·113
Sept. 4, 5, 6	Sept. 5, 6	8·82	92·7	·547
	Sept. 6	8·68	94·2	·057
	Do. (other stars) ...	8·62	94·8	·097
	Sept. 7	8·83	92·6	·060
	Sept. 8	8·81	92·8	·134
	Do. (other stars) ...	8 70	93·9	·097
	Sept. 9	8·82	92·7	·145
	Sept. 10	8·66	94·4	·309
Sept. 11	Sept. 10 (other stars) ...	8·67	94·3	·106
	Sept. 19	8·75	93·4	·077
	Sept. 24	8·70	93·9	·109
Sept. 27	Sept. 25...	8·86	92·3	·147
	Oct. 3	8·81	92·8	·110
	Mean	8·782	93·07	
	Probable error 0″·012 | 100,000 miles.			

Thus it would appear that a satisfactory set of observations on a single morning and evening is capable by this method of doing as much towards the solution of our great problem as a considerable number of Transit of Venus expeditions. Now for £500 we have 23 such sets of observations of Mars, whilst a single set of Transit of Venus expeditions cost something like £50,000. In an economical point of view, therefore, there is an enormous preponderance in favour of this method.

The definitive combination of all these results gives 93·07 millions of miles for the sun's distance, with a probable error of 100,000 miles. Mr Maxwell Hall, a private astronomer in Jamaica,

also observed this opposition of Mars, after the original method proposed by Airy, viz., by observing the passage of Mars and a star across the webs of his telescope, in the evening and morning. He derived the mean result of 93·0 millions of miles, but the probable error of his result is just five times as great as that derived from the heliometer observations, and considered by itself would be of very little value. So far, however, these results confirm those at which I arrived.

Let us now review briefly the history of our problem in the first place up to the date previous to 1870. We have the following:—

	Millions of miles.
From 1670 to 1800, the result of Cassini, derived from observations of Mars at Cayenne, combined with observations in Europe	81·6
From 1800 to 1830, the result of Laplace, derived from his discussion of the Transits of Venus of 1761 and 1769	92·8
From 1830 till about 1858, the result of Encke's elaborate discussion of the Transits of Venus in 1761 and 1769	95·2

After 1858, we have amongst others:

1.	Mr. Stone's rediscussion of the Transit of 1769 ...	91·7	92·0
2.	Mr. Stone's discussion from the Parallactic inequality	92·0	
3.	Velocity of light (Foucault) ..... Constant of Aberration (Struve)	92·0	
4.	Opposition of Mars in 1862 (Stone)	92·0	
5.	Leverrier, from Planetary theories	92·2	

It was apparently with good reason that about the year 1868 the question of the sun's distance appeared to be settled within very narrow limits. But if these facts are absolute, they are irreconcilable with the result of 93 millions of miles derived from my observations of Mars.

Let us now examine the results of more recent investigations.

The following table gives the results of the principal discussions or determinations since the year 1870:—

	Millions of miles.
Method (1).—Transits of Venus—Powalky's rediscussion of the Transit of Venus of 1769 gives...	93·0
Airy, from the observations of the British expeditions to observe the Transit of Venus of 1874 deduced	93·4
Stone, from the same.....	91·8

And other discussions have given results between these extremes.

		Millions of miles.
Method (2).—Parallactic Inequality.—Neison's most recent results give		93·1
Method (3).—Velocity of Light.—Michelson and Cornu's velocity of light combined with:		
Struve's constant of aberration	92·8	93·05
Glasenapp's value of the *light equation*	93·3	
Method (4).—Gill, from observations of Mars		93·1
Maxwell Hall, ditto ditto		93·0
Method (5).—Newcomb's preliminary corrections of Leverrier's result from the planetary theories ...		92·6

It is the same old story with the Transit of Venus—the doctors differ—and the reasons for this I have already explained. I have also shown why some doubt attaches to the last mentioned result of Leverrier, because his tables do not now sufficiently satisfy observation.

The second method has been improved by Mr Neison; he employs a spot on the moon instead of the moon's limb, and though we have not yet the details of his observations and results, still his work confirms the distance of 93 millions of miles.

The method of the velocity of light also strongly confirms this distance, and I think we are entitled to conclude that the most probable value of the sun's distance may be considered to be 93 millions of miles.

I have thus endeavoured to redeem my promise of showing how the standard yard measure is applied to determine the sun's distance. First it is applied to the measuring bars of the base lines of our geodetic surveys. Next, these surveys are extended by triangulation over considerable areas of the earth's surface, and then by combining the curvature of the earth's surface, as determined at different points, the form of the earth and its dimensions in terms of the standard yard are computed. Finally, with the earth as a base line, I have tried to show clearly how the distances of the planets Mars and Venus have been measured, under certain favourable conditions, and how these distances have been employed to deduce the distance of the sun.

Though time did not permit me to enter into details of the methods by which the velocity of light is ascertained, it will be obvious that the yard measure must be used to determine the distance over which the light is made to pass during the experiments. The velocity of light, in terms of the standard yard, being so determined, I have shown how the sun's distance is ascertained through this determination by two independent astronomical

methods, and how thus by six independent results the great astronomical base has been measured ninety-three millions of miles!

These are no high sounding words with which to conclude this long and, I fear, somewhat tedious history; and yet they are the best I can offer you, in that they contain some close approach to a great truth. I have endeavoured, to the best of my power, to trace the winding rock-strewn way by which such truth has to be arrived at. May I hope that I have brought you along with me, and that I have been able to show you in some degree, not how much, but rather how little we know. Surely nothing can teach a more striking lesson of humility than a history, such as I have given, of the struggle to catch one ray of the Divine intelligence which surrounds and upholds us. You see what labour, what concentration, what devotion are needed, not only by individual men, but by successive generations of men, in order to advance one step in the upward path which leads to the glorious God-born truth. You see with what care and caution, with what deep thought and anxious questionings have been laid the foundation-stones of the fair structure of modern Astronomy. A fair and noble structure truly, and one that fills the soul with an earnest longing to raise it a little higher; for, alas! it is no ladder reaching unto Heaven,—only a wayside Bethel with its spire pointing skywards.

We know that our eyes are toward the light, but we only see through a glass darkly, for the time has not yet come when we shall know even as we are known, and rejoice in the full understanding that

THE HEAVENS DECLARE THE GLORY OF GOD.

THE TRANSACTIONS

OF THE

South African Philosophical Society.

I. *The Geography of South-Western Africa.* By H. C. Schunke.

[Received Jan. 10, 1879.]

For some considerable time back the writer's attention has been drawn to the River system between the Cunène and the Liambey, and it was his great wish to go to that part of Africa to explore; but has as yet—on account of ill health and for other reasons—not been able to go sufficiently far inland to discover anything new to geographers.

To make up for it he has been engaged for some years in gathering information on the geography of South-Western Africa, and is now preparing a map of the regions between the latitudes of Walvisch Bay and Mossamedes and as far east as the Victoria Falls on the Liambey. It is to be accompanied by a description of the country and examination of the available data for the construction of the map. Some months more will be required to complete this, and the writer therefore intends to give here in a few words a prodrome to the work.

In giving a short description of the country lying within the limits of the map we may begin with the Coast region between Walvisch Bay and the Cunène. It is dry and sandy and almost entirely destitute of water. Near Walvisch Bay this strip of desert is broadest, gradually diminishing and ending at the mouth of the Cunène. No vegetation, excepting near the dry river-beds, is found on the ever-shifting sand-hills, only near Walvisch Bay we have the Nara plant bearing a melon-shaped fruit.

Then we have Hererôland comprising the valleys of the Tzoachaub and Omaruru, the Omuramba ua Matako, eastwards the sand-flats of the Omahcke and to the north the Otjozondjupa

Mountains or Waterbergen. The greater part of the population, Ovahererò and Ovàmbantieru, are found along the Tzoachaub, the Omaruru and Omuramba ua Matako which are periodical rivers, with numerous fountains and water-pits. In consequence most of the Mission stations are found on these rivers. Otjimbinguè, Otjikango, Okahautja (the great Chief's place) and Otjozasu and Windhoek are situated on the Tzoachaub and its affluents— Okombahe, Okozondje and Omburo are on the Omaruru river.

The course of these rivers and also the general physical features of the country around them have been very fairly delineated by travellers and missionaries, and especially the routes from Walvisch Bay to Omaruru and from Walvisch Bay to Otjimbinguè and Windhoek form a base to a rough survey of the country.

North of the Omaruru river, rising rapidly from the Coast-desert, a very mountainous district extends to the Cunène, known as the "Kaoko." Its western part is very rugged and cut up by numerous periodical westward-flowing rivers, containing in their beds fountains of fresh water. On account of the almost insurmountable difficulties of the terrain for making roads through this country it has been *terra incognita* to white people until 1877, when two missionaries of the Rhenish Society, Messrs Böhm and Bernsman, ventured to traverse it. They travelled from Okombahe on the Omaruru north-westwards and almost parallel with and at a mean vertical distance from the coast of about 60—70 miles until they arrived after a long and tedious journey at Ohamuheke, called by the Namaquas Zes-fontein, in about the latitude of Cabo Frio (according to *their* log), probably the point is not so far north, as travellers who go over a difficult road and who lay down their points without the aid of astronomical observations, only keeping time of travelling and direction by compass, are as a rule apt to exaggerate their distances. The description the travellers give of Ohamuheke and other places is indeed favourable; the quantity of water found there being even in excess of that issuing from the slopes of the famous Otjozondjupa.

The missionaries returned partly by a route more distant from the coast, joining again their old tracks at Ondijombo ya hambeke, and returned to Okombahe highly satisfied with the result of their inspection tour.

The altitudes of the places passed through on going to Ohamuheke give an average of about 1700 feet; on the return road more inland an average of 3300 feet above sea level was obtained. The fountains and pits in the Kaoko contained fresh water, and grass is found almost everywhere; the travellers say that the strip of desert opposite Ohamuheke must be much narrower than at Walvisch Bay. The climate is on account of the fresh water and the elevated position very healthy.

The Kaoko was inhabited formerly by Hererò, who gradually migrated south-eastwards towards the Omuramba ua Matako and the Omaruru and Tzoachaub, where they found brackish fountains, which they prefer to the fresh water in the Kaoko. Some of the Hererò were driven to the mouth of the Cunène by hordes of Namaqua in Jonker Africaander's days, and are now exceedingly hostile towards white people; they have several times driven traders and hunters back, who to avoid the long and wearisome journey to Walvisch Bay sought a way to Great Fish Bay or the mouth of the Cunène or even to Mossamedes.

I may here add that the Kaoko is part of the reserve placed at the disposal of the English Government by the Hererò Chief Kamahererò, and will perhaps one day prove useful—there being at present hardly any natives.

From the Kaoko eastwards there is an extensive high plateau of an average altitude of 3500 feet. It is covered with a vegetation of thornbush and grass; water is very scarce there. The plateau slopes to the north and east towards the Omuramba u Orambo and the Omuramba ua Matako. On the south and south-east side it falls abruptly and has all the appearance of a high mountain-range, like the Free State and Transvaal plateaux when looked at from Natal or Zululand. Numerous fountains issue along this south-eastern slope of the plateau, and amongst them are the most interesting and important springs of the Otjozondjupa or Waterberg. The vegetation is here luxurious, and much land could be brought under cultivation. East of the Omuramba ua Matako we have the Omaheke or Sandveld, a dry and sandy desert extending eastwards to Lake Ngami. In fact, between the Omuramba and Ngami a horn of the Kalahari desert pushes itself in as far as latitude 17° S. gradually diminishing in breadth, and making access to the great rivers to the north-east almost impracticable. Hardly any water is found in this bush-covered desert, only a kind of water-melon thrives here and gives means of subsistence to wandering Bushmen and cattleless Hererò called Oratjimba.

To the north of the high plateau of Damaraland above described we have the plains of Ovampoland, containing much fertile alluvial soil covered with a thin layer of fine white sand some inches deep. The population is composed of agriculturists divided into various small tribes headed by independent chiefs. Not a stone is found in this region except some very recent calcareous formations near the fountains. A great part of the country is subject to the inundations of the Cunène and its affluents. Higher up east of the Cunène the country becomes still more fertile, the vegetation more luxurious, game more abundant, but the climate also more unhealthy. The Cunène described by the two or three travellers who have reached its

banks from the south side is a beautiful river and well navigable for smaller boats (like Stanley's "Lady Alice"). It has been lately found that the mouth is not obstructed, and thus the Portuguese government are having two small steam-boats built for the Cunène river navigation.

The Cunène rises on the highlands—crossed by Cameron on his walk across Africa—to the south of Bihè close to the sources of two other very important rivers: the Cubango and Quatu. After flowing for some distance in a southerly direction the Cunène bends to the west and discharges its waters into the Atlantic not far south of Great Fish Bay, forming thus the southern boundary of the province of Mossamedes.

Bordering the desert which lies east of Ovampo and Hereròland a large river flows south and south-east—in its upper course called Cubango, in its lower Okavango. In 1859 C. Andersson the Damaraland traveller reached this river near the Chief Tjikango's place and found a tribe who cultivated the soil on both its banks. Andersson was unable to ascertain much about this river, as to where it came from and where it flowed to: he simply fixed the position of the point where he touched the river. Whether this river was in connection with the Cunène or the Zambesi or the Teoghe he did not know. On the map of Dr Petermann this river is made to join (though with a dotted line) the Omuramba u Orambo. That this is entirely incorrect I am in the position to shew.

More than twenty years ago the Portuguese government employed the Hungarian, Ladislaus Magyar, who had been officer in the Austrian navy, to explore the rivers Cunène, Cubango and Quatu. The result was as follows: Magyar found that the three rivers rise on the same highland and not far from one another. The Cunène flows south and south-west; the Cubango and Quatu (Kntatu) first diverging then flowing parallel to the south-east. The Cubango is according to the description of Magyar the same as the Okavango. Some distance south of the point where Andersson touched the Okavango, the river turns to due east and flows into the larger and deeper Quatu, one day's journey west of Libebe, which Magyar calls Darica. According to Magyar the united rivers under the name of Teoghe or Tonke River flow into Lake Ngami after having sent off a branch stream towards the Zambesi called the Tsò.

Magyar died before he could publish his whole work, and many of his notes were lost.

It was believed by Dr Petermann and some others that Magyar had exaggerated his distances and that the confluence of the Quatu (or, as Petermann has it, Cuito) and Okavango *must* be far above the point where Andersson touched the Okavango, and that

Teoghe and Cubango or Okavango had nothing in common, that they are entirely unconnected rivers. The points Darico and Bunja are thus thrown some hundred miles away from their actual positions, and the Okavango, according to Andersson and others a navigable stream, is forced to join the Omuramba u Orambo, a periodical river. The Teoghe takes its rise in a sandy desert near Libebe, instead of near Bihè in the latitude of Benguela. According to Dr Petermann, the Cubango and Quatu (Cuito)—both called by the Portuguese "Rio caudoloso," which means strong, broad, rapidly-flowing stream, in fact a large river—are supposed to disappear in the sand-bed of an Omuramba. The writer carefully studied the letters sent by Magyar to Professor Hunfalvy at Pesth, and also his official despatches to the governor of Benguela, besides Andersson's "Okavango," and cannot conceive how Dr Petermann can have arrived at such conclusions. It is beyond doubt by Magyar's papers that Darico and Libebe are one and the same place, and that the Cubango (Okavango) and Quatu (Cuito) join, a day's journey west of Libebe. The name of the tribe at and near Libebe is "*Baviko*": is it not possible that Darico stands for Bavico? Very often in Africa the names of tribes are given to places. In African languages there is not much—we may even say there is no—difference between *v*, *l* and *r*, so it is easily possible that the *v* in Bavico has been changed into *r*. The prefix *Da* is there instead of *Ba*. We must not be astonished at its being wrongly put by Magyar, for the Portuguese and many travellers constantly are putting wrong prefixes to names of places. Perhaps Magyar was not familiar enough with the rules of African languages.

To my greatest joy I saw my confidence and belief in Magyar's observations confirmed by the writer of an article (not exactly unknown to me but who does not give his name) in the "Argus" in the beginning of 1876. He—perhaps not knowing even that Magyar had travelled over the same parts more than 20 years before—confirms everything Magyar says about the Okavango and Quatu. The unknown writer crossed the Okavango at the same spot where Andersson touched the river in 1859.

After having travelled eastwards over a flat country slightly elevated above the Okavango and having crossed the Omurambaa, Okafumu and Okakenny he found himself within a day's journey of the Great Quatu River. He was however compelled to retreat on account of the tsetse fly which threatened to destroy his valuable—very likely salted—horses. He states also that the Okavango flows due east from near Bunja and joins the Quatu a short distance west of Libebe. That the united rivers are the Teoghe or Tonke the writer of the article was fully able to say, because he had travelled from Lake Ngami to Libebe years ago.

This refutes Dr Petermann's geography of this part of Africa

entirely, and proves that Magyar was right. We have seen that the unknown writer of the "Argus" article agrees also in the position of the confluence of the two streams with regard to Tjikongo's place, Bunja and Libebe, and therefore Darico is Bavico or Libebe. The Rev. Dr Hahn who has lived many years in South-West Africa and has travelled much, who was one of the first who reached the Cunène from the south, expresses himself very favourably for Magyar and believes him to be highly trustworthy.

Both rivers are navigable for cargo-boats, and Andersson has also shewn that the Teoghe is navigable from Lake Ngami.

The writer cannot understand why Magyar should have been misunderstood by great geographers, though his papers shew that he carried instruments, and being a naval officer he very likely was accustomed to their use.

From the Okavango an Omuramba branches off not far from the point where its course becomes entirely east near Bunja. This Omuramba is called Sheshongu and it joins the Teoghe. It is mentioned by Green and is also shewn on Mr Palgrave's map of Damaraland.

For the present the writer will say no more about the subject until he is able to lay the map before the Society, and will then go more minutely into the question of the river-system of South-Western Africa, and will shew his sources of information more clearly.

II. *On the Stone Implements of South Africa.* By E. J. DUNN, F.G.S.

[Received March 25, 1880.]

Enough work has not yet been done nor have sufficient implements been collected to admit of generalizing, but in a field so extensive as South Africa where instruments and weapons of stone abound, not only distributed over the surface, but imbedded in the soil to a depth of many feet, the necessary interest is certain eventually to be excited and the material obtained for more elaborate work than is at present possible.

Collections have been formed by Dr Dale, who discovered and made known the remarkably well-formed and varied types of implement found on the Cape Flats near Salt River; the discovery was made about sixteen years ago, and numerous examples have been forwarded to Europe. Representative specimens are deposited in the South African Museum, the Christy Collection, the Oxford Museum, and in the private collections of Sir J. Lubbock and

Professor Busk: Dr Dale contributed an article with illustrations to the Cape Monthly Magazine for October 1870.

Among the best-known collectors of stone implements in South Africa are Mrs Barber, Commandant Bowker, Mr T. Bain, and Mr M^c^kay of East London.

As the Kaffirs adopted iron for cutting and piercing instruments from remote antiquity, and as they brought the art of working that metal with them from their more northern homes, all such implements of stone may safely be attributed to other races. As proving who the makers of the stone implements were, there is the fact of their employment, even now, by the remnant of the Bushmen; and in the case of the Stormberg district, where numerous rock-paintings, and dwelling-places on the hill sides with refuse heaps consisting of ashes, charcoal, fragments of bones of game, valves of unio, stone implements, &c. occur, there are still inhabitants who remember when these places were the haunts of the little red men, whose passion for the Boers' cattle and horses led to their extermination; this district has never been inhabited by either Hottentots or Kaffirs, and therefore the remains may be considered of genuine Bushman origin.

In South Africa, where no flint is found, its place is supplied in the manufacture of implements by such hard silicious rocks as quartz-rock, milky-quartz, rose-quartz, cherty sandstones, chalcedony, agate, jasper, silicified wood, and most frequently of all, over the Karroo area, a black description of hornfels formed from shale or fine sandstone where in contact with intrusive rock. This substance is admirably adapted for cutting-tools, and is easily shaped as it breaks with subconchoidal fracture.

On the Cape Flats, near Salt River, a cherty sandstone, in some cases extremely close grained, in others the grains very coarse but cemented together by silicious matter, was more generally used for implements; it is of Tertiary age, and obtainable near the tenth mile-stone, *in situ*, the farm where Langalabilele is confined, and at several other localities on the downs. Agate, jasper and rose-quartz have been most commonly used along the course of the Orange River; on some of the flat topped isolated hills along its course, flakes and chips are plentifully strewn, at an elevation of two to three hundred feet above the stream.

Some of the stone implements are of great antiquity; there is great difficulty in deciding as to the age of any particular specimen, unless the conditions under which it occurs yield the information; it does not follow that because an implement is found on the surface it is therefore of recent make, for the ground might be hard and thus prevent its becoming buried; on the other hand, the discovery of flakes and pieces of pottery at considerable

depths, in undisturbed slowly accumulating deposits, justifies the assumption of remoteness proportionate to the conditions of the accumulation.

During a trip through Bushmanland, stone flakes, &c. were frequently seen, and occasionally in great abundance, very often associated with enormous quantities of ostrich egg-shell, as at Klaver Vley, Nauta, Leeuweklip, &c. At "Process Font," near Victoria West, the river has cut a channel in the plain, exposing the following section in descending order:

Loose red drift sand	1 foot,
Dark clay	3 feet,
Hard calcareous bed	2 feet,
Fine gravel	2 feet.
	8 feet.

The floor is of Karroo shale and intrusive rock. From the top of the red sand to the bed rock, chips and flakes of black hornfels are disseminated; in the calcareous layer, a sharp blow with a hammer is necessary to free the flakes from the matrix. I did not observe any scrapers. Considering the nature of the adjacent country, which is very flat, and the nature and appearance of the deposits, it is reasonable to assign a considerable age to the implements in the lower strata.

At another and distant locality, viz. between Queenstown and Molteno, on Judd's farm "Kloppers Fontein," flakes of similar material to those observed at "Process Font," and up to five inches in length, occur on the surface and down to the bed rock, a depth of twenty-five feet. In this case, the valley is narrow and filled with loam and gravel; the rate of accumulation was, no doubt, more rapid than it would have been in a broader valley, but even making all allowances, the implements cannot be considered as of modern age. The section is exposed through the water having cut a gulch in the soil; like most similar instances the running of stock was the means of starting the erosive action.

In the Camdeboo district, on the farm "Osse Hoek," close to its junction with the west side of "Lange Fontein," is a marshy piece of ground from which a spring issues; during the drought of 1878, an effort was made to increase the supply of water by cutting a deep trench up to the eye of the spring, where the eye was tapped; the cutting was nine feet deep, and here, in beds that appear never to have been disturbed—for they have a rude kind of bedding—was found a small Bushman pot of baked clay; it was below several pieces of rock, probably placed there to prevent game from drinking, as was the custom with the old Bushmen.

The position of the marshy ground is at the base of a low ridge and by no means favourable to rapid growth of sediment.

The section is as under:

Black marshy soil full of roots.....	3 feet,
Grey marshy soil with decayed roots	4 „
„ „ without roots	2 „
	9 feet.

Pot of baked clay under stones.

From appearances, it is probable that a considerable period has elapsed since the vessel was dropped or placed in its position.

At Constantia, perforated stones have been dug out at a depth of three to four feet below the surface; similar stones were dug out on the flank of Devil's Peak, above Rondebosch; and at Oaklands, Claremont Flats, a small irregularly shaped perforated stone and numerous flakes were found resting immediately on the white clay (decomposed granite) at a depth of 1 ft. 6 in. below the bottom of a vley.

In many places on the Cape Flats, there is a stratum of gravelly material reposing on the decomposed granite or on the tertiary beds, it is from six inches to one foot thick; flakes, chips, and rudely formed implements are common in it.

Covering this layer is from one to two feet of soil in which no flakes or chips occur.

Near Salt River, flakes, chips, and spear-heads are imbedded in the bog iron ore that abounds on the flats.

Some implements found on the surface wear the aspect of great age; examples were numerous around the margin of Du Toits Pan and several other vleys at the Diamond Fields, in the early days of the diggings; flakes, spear-heads, &c. formed of extremely hard lydianized shale, were quite rounded in outline, and on fracture shewed a thin decomposed shell on the outside, indicating a lengthened exposure to the atmosphere. Much-weathered implements are met with throughout the Karroo country.

A broken borer or rimer, found on the farm "Weltevreden," Stormberg Spruit, supplies evidence of the great age of some stone implements; it is made of the usual black intensely hard altered shale, and was used long ago for perforating stone; it was lost or discarded, and after a considerable lapse of time again found, and used for the same purpose; the friction broke off some small chips, and by some means the rimer also broke across at three inches from the point, and was of course of no further use; the fracture on the end of this piece is black and quite fresh-looking, while the remainder of the stone, where not rubbed by its last employment, is covered by a decomposed grey shell about four times the thickness of a sheet of foolscap; now, the last fracture is certainly not less than forty years of age, for the Bushmen were driven out of, or shot, in the Stormberg district about that time; if forty years have

made so little impression on this stone, how long must the original implement have been exposed to become so much weathered?

Since man's appearance in South Africa, the surface of the country has undergone very considerable alteration; in fact, there are direct proofs, from the presence of stone implements, that the aborigines roamed over this country before the soil, covering the bed rock of many of the present valleys, was washed down from the hill-sides; and here it is worthy of note that the alluvial deposits were accumulating and continually filling up the valleys higher until the old and natural order of affairs was disturbed by the presence of the white man and his unnatural method of depasturing stock, since which time, the storms have cut into and are rapidly removing these alluvial deposits; especially along the base of such mountain-ranges as the Stormberg. It is in these rifts the implements are now laid bare.

Speaking geologically, it appears that stone implements have been in use since the beginning, or nearly so, of the Recent period, but none have been found in the later Tertiary deposits.

In all probability, fragments and pebbles of stone were first utilized by primitive man; very soon it would be discovered that more efficient tools might be formed by chipping stones into shape; the art of perforating, grinding, and polishing stone would follow. The most suitable descriptions of stone for different purposes would be taught by experience.

The cutting implements of this country are very similar in form to those found in the River Drift of Great Britain, as figured in Dr J. Evans' work; but little art appears to have been exercised in their manufacture; only one instance of an axe having been slightly ground at the edge has come under my notice; it is represented in Fig. 22, but the ground edge is not well shewn; I found it myself, or I should have felt some doubt about it. The beautifully shaped highly finished greenstone axes of the Australian black are works of art, compared with the rude Bushman implements of the same kind; the difference may have arisen from the fact that the blacks dwelt in a country of forests, and obtained much of their food from trees, while in South Africa the general absence of trees rendered good axes almost superfluous.

The objects figured and enumerated are in my collection, and have nearly all been personally discovered.

With regard to the spear-heads, &c. found on the Cape Flats, there appears good ground for hesitating in attributing to them a Bushman origin, for in the haunts we know to have been occupied by the genuine race, no such highly worked examples are found; possibly they belong to a branch of the Hottentot family.

There is some difficulty in deciding what were Bushman and what Hottentot implements, especially in tracts once occupied by both.

The types of implement already met with comprise the following:

Hammers	Spear-heads
Cores	Arrow-heads
Chips	Axes
Flakes or Knives	Flat stones for grinding on
Saws	Mullers or grinders
Scrapers	Rubbing stones
,, notched	Grooved stones
Borers or rimers	Perforated stones

Hammers.

One of the first applications of stone would be for striking with, and when sharp flakes were required a hard pebble was no doubt soon found to be a convenient and efficacious tool in detaching them from a piece of stone. Such hammers, with bruised ends, are of common occurrence; they are generally of quartz-rock, quartz, hard sandstone, jasper or some other equally compact material.

Frequently the stones used as mullers, &c. are battered on one end from use as hammers. In some cases implements, on which some work has been bestowed, have been used as hammers, such as Fig. 25; but there is uncertainty about the original intention of the maker, it represents a quartzite implement from "Van der Walt's Kloof," Camdeboo; there is a shallow circular depression on opposite sides, and it looks as though originally intended for a perforated stone, but the material proving so refractory, the intention was abandoned, and the stone utilized as a muller, as is clearly shewn by the wearing down of one side, and also for hammering, as the battered sides prove.

Cores.

When the qualities of different rocks had been learnt, such as combined hardness with a conchoidal fracture were selected for the manufacture of knives, scrapers, spear-heads, &c., and when a fitting piece of stone was secured, as many flakes as possible were detached, and the central piece was discarded; such remnants are called cores, and are found from the Cape Flats to beyond the Transvaal. They are most commonly similar in form to Fig. 17, some are more spherical, such as Fig. 18; the former is from "Twee Fontein," Stormberg, the latter from "Weltevreden," same district.

These cores are sometimes found at considerable distances from the site of the parent rock; it is probable that a small block of specially good stone formed part of the kit of these primitive men, and was used for making knives, arrow-heads, &c., as occasion required.

Chips.

Artificially detached fragments of stone without definite form are more abundant than shaped implements, as would be expected, for in the process of making some implements, many small chips would be struck off, and many failures would occur in forming even the simplest implements, such as arrow-heads, &c.; as a matter of fact, hundreds of such shapeless fragments are met with to one complete instrument.

In the vicinity of the vleys near Salt River, and sometimes on the floors of the vleys, are sites that appear to have served as manufactories of stone implements, judging from the numbers of chips imbedded in the soil and strewn on the surface; they are principally of the cherty sandstone of Tertiary age, and quartz, with a few pieces of rose quartz.

Over the Karroo, chips are to be seen almost everywhere. Near the sparsely distributed fountains of Bushmanland, chips of stone, as well as implements of the same material, abound; they are found mingled with the débris at the mouth of the caves and shelters of the Bushmen in the Stormberg. These mounds of débris are frequently two to three feet thick, and sometimes even more, and consist of ashes, charcoal, bones of game, bits of pottery, stone implements, pieces of stone, &c.

Flakes.

Of the various uses to which stone was applied, none was more common than the shaping of knives; the frequency of sharp-edged flakes, similar to Fig. 1 (from the vleys near Salt River), is proof of their common use. Some are worn at the edges, but on most no direct evidence of wear is observable; it is natural to suppose that an implement detachable by a single blow was not highly valued, and would be cast aside after but little use. Even in the primitive life of the Bushmen, a constant requirement of a cutting instrument existed, nor could they have skinned game, cut up its flesh—so as to place it in their small clay pots—and made bows and arrows without one. It is quite possible that some of the sharp flakes were either rudely hafted with a piece of stick, or by having fibre wrapped over the part to be held in the hand.

Saws.

Flakes similar in form to those used as knives, but having one or more of the edges systematically serrated, are widely distributed; they would be of great service in severing such sticks as were used for digging with, for bows, and for arrows where reeds were not within reach; Fig. 4 represents such an implement from near Salt River, Cape Flats.

Scrapers.

After simple flakes, scrapers are the most numerous and widely disseminated. In form they are identical with European types, the horse-shoe form predominates. Fig. 5 is from Queenstown.

They are formed of flat flakes; one or sometimes both ends have been shaped into more or less semicircular form by striking off fine chips, the blows being given on the flat or bulb side of the flake.

Traces of use are frequent; the curved edges in some specimens are quite rounded from this cause. No doubt they served for many purposes, such as for scraping the integument from the inner side of skins; for scraping bows and arrows into shape; in the manufacture of their bone-spoons, awls, arrow tips, &c.

Near the hospital, Queenstown, they abound on the surface of the red soil, also in the vicinity of the old dwelling-places of the Bushmen, in the Stormberg, in Bushmanland, over the Karroo, in the Free State, in the neighbourhood of Buffel's River, Beaufort West railway, and more rarely on the Cape Flats; where they are usually of much larger size.

Most of the scrapers are made from highly indurated shale of black colour, but many other descriptions of stone were availed of; in fact, as with all other stone implements, the best material within reach was employed.

Some very narrow examples have been noticed. Straight-edged scrapers were also used.

Notched Scrapers.

Flakes, in the sides of which notches have been chipped, are not uncommon. Fig. 2 is from near Salt River, and appears to have been used or intended for a spear-head, but was subsequently turned to account as a scraper of this kind. Such an instrument might have been used for fashioning the bone points of arrows, or for rendering arrow-shafts, when formed of wood, of cylindrical shape. The notches bear evidence of having been formed by design, and not by accident, and shew distinct evidences of having been rubbed in some cases.

A larger notched implement, from the same locality as the last, is represented by Fig. 3; it is the only one of the kind that has come under my notice.

Borers or Rimers.

In the Stormberg, I met with numbers of implements of pointed form similar to Figs. 14 and 15. The former is from a cave, "Buffels Kloof," Stormberg, and the latter from the Cape Flats.

From an examination of several dozens of specimens, I have no

hesitation in considering them to be the tools used in perforating the spherical digging stones; they are always made of the hardest material obtainable, such as shale or sandstone that has been indurated by intrusive rock; they are trimmed into an elongated form, and are from three to six inches long. At one end, or in a few instances at both ends, the sharp edges of the chipped stone are rounded off; the points are sometimes ground into nearly cylindrical form from the rotary motion employed in using the drills. The points often bear testimony to these stones having been employed as picks, as well as for riming out the holes. Very many broken points are met with, the fracture is a sharp one, and a little consideration will explain their abundance, for the effect of riming out an irregularly shaped hole in a stone that had only been previously picked with a stone implement having projecting angles would often be to cause a jarring motion, and thus to snap off the hard but brittle material employed for drills.

These rimers have been met with in greatest numbers in the Stormberg, commingled with the débris that marks the sites of the old Bushmen's habitations, and are found from the surface downwards, associated with whole and broken perforated stones. As none but Bushmen dwelt there, no other conclusion can be arrived at, than that they were used by the Bushmen, and for the purpose of perforating stones; probably this operation was performed by the women, as the spherical stones are used by the women, and it is not probable that the men made them.

Similar drills are obtainable throughout South Africa, where stone implements occur, but not in such numbers on the Cape Flats as in the Stormberg.

Small borers or awls of stone are obtainable in the Stormberg and in Bushmanland; one from the former district was formed by chipping a thin flake of hard shale to a point at one end, leaving a shoulder on each side of the boring-point; they were used for perforating the small discs of ostrich egg-shell, formerly so extensively used as beads; these small discs are about $\frac{1}{4}$ inch in diameter, and are made by first breaking the egg-shell into small fragments about the required size, then perforating them by a hole from either side, and finally grinding them into circular shape.

Fig. 16 is of sharp gritty sandstone, and was found in the Stormberg; other slender pieces appear to have been used as files in finishing the holes in spherical stones. The point of the specimen figured has been rounded, shewing that the implement was worked in the same manner as the drills.

Spear-heads.

Rude spear-heads such as Fig. 7, from the Cape Flats, are common throughout the country; this type has been used precisely

as it left the core, without any subsequent chipping; it is about the simplest form of spear-head. A comparison of several similarly formed spear-heads renders it very apparent that more skill and care is required to form even such an implement than appears at first sight. In making such a spear-head the flake was shaped on the core by first striking off smaller flakes, at least one on each side, and one or more at the end of the implement furthest from the point; the butt end was thus thinned, perhaps with the object of inserting the spear-head in the split end of a stick, where it could be secured by means of fresh sinews; whatever the intention of thus flattening the butt of the flake, it is almost an invariable character. After the preliminary flakes or chips were struck off, the decisive blow was delivered, and the finished implement detached. Considerable skill must have been exercised in regulating not only the point at which the blow had to be delivered, but also its intensity, for a miscalculation in either direction would have marred the result.

Evincing more care in its manufacture than the preceding is the type represented in Fig. 9, from the same locality as Fig. 7; in this case, after the spear-head was detached, a better form was imparted by removing numerous fine chips from the edges. The side on which is the "bulb of percussion" in such implements is generally left untouched; this and the preceding form of spear-head are the most plentiful, they are far more abundant about the margins of the vleys near Salt River than further inland.

On the Cape Flats they are found to be most numerous in the vleys where a passage led from one to another, or under such banks as would give cover to a hunter, and from which he could hurl his weapons at the game that no doubt thickly covered the surface of these lagoons in ancient times. Many of the spear-heads found in such positions have lost their points, as though from striking some hard object.

Implements shewing an advance on Fig. 9 are met with, resembling Figs. 12 and 13, but only worked on one side, the other being flat; shewing a far higher degree of skill in manipulating stone are types such as Figs. 10, 12 and 13, they are formed of cherty sandstone of Tertiary age, and are from the Cape Flats; they are beautifully shaped and highly finished on both sides. The material is far less easy to work than flint, and taking this into account it would be difficult to find a higher degree of skill displayed in any similar implement of European manufacture.

Highly finished examples of the forms Figs. 12 and 13, but eight or nine inches long, have been discovered by Dr Dale.

Partially formed spear-heads are occasionally met with on the Cape Flats, that shew the manner in which such implements are formed from a fragment of stone.

The highly wrought spear-heads, &c. found on the Cape Flats, so far excel anything of the kind found further inland, as to render it doubtful that they were formed by the same race as we know fashioned the less perfect types. The early records of Cape Colony speak of certain Strand-loopers who lived on the Flats, but they are described as few in number and very degraded, subsisting principally on shell-fish and roots, the latter of which they are represented as procuring by means of digging-tools of iron, probably obtained from some English ship that had touched at the Cape. Perhaps the Hottentots, of whom there was a considerable population, were the makers; they were certainly much further on the road towards civilization, as we understand it, than the Bushmen were. The Hottentots in the earliest days of settlement were possessed of great wealth in horned cattle, they had comfortable mat houses, and acknowledged leaders; as from necessity they employed stone for various purposes, it seems only reasonable that they would shape it with more precision than their wilder neighbours.

There are some few facts observable on the Cape Flats, near Simons' Town, and near Cape Point, that would almost imply that the art of smelting metals, or at any rate iron, was not unknown to the original inhabitants of the peninsula; a specimen from near Simons' Town, at present in the South-African Museum, appears to be a rude nozzle of clay, such as the natives in the interior use even now in smelting iron; adhering to this nozzle is a piece of slag. I have observed one similar nozzle on the Cape Flats.

Arrow-heads.

Small triangular pieces of worked stone, evidently intended for points of arrows, are widely distributed; they are rudely formed, resembling Fig. 6, from the Cape Flats. From the same locality as Fig. 6, examples, on which more work has been bestowed, are not uncommon, such as Figs. 8 and 11.

These arrow-heads appear to have been intended for insertion in a groove cut in the end of the arrow shaft, any tendency to split in the shaft being prevented by a binding of sinew such as used by the existing Bushmen.

While in Bushmanland an old Bushwoman, living on Leek River, shewed me one of the methods adopted in affixing stone tips to arrows; two small triangular flakes were detached from a piece of hard stone, they were as nearly alike as possible, the point of the shaft was then flattened and coated with resin obtained from a small pelargonium, this resin is softened by heat, and the two flakes pressed on the opposite sides of the flattened tip of the shaft, the points being carefully brought together; the bases of the arrow-heads were some distance apart. The use of iron has entirely superseded stone for arrow-heads among the Bushmen of

the Orange River, a small triangular piece of tinned plate being found far more effectual than a stone flake.

Since none of the Kafir tribes use bows and arrows, the arrow-heads met with may be safely considered as of either Hottentot or Bushman origin.

No notched, barbed, or tanged arrow-heads have been noticed.

Axes.

Most examples met with are of very rude form, some strongly resemble European River Drift types. There are two prevalent shapes, the one like Fig. 23, but generally more pointed (the top of the figure is the pointed end); such weapons could not have been of much service for cutting, but perhaps were mounted in a handle and used as offensive weapons. Fig. 23 is made of indurated shale, it has been so long made that a thick shell has decomposed, it was found at "Oorlogs Kloof," Stormberg. Fig. 24 is of the same material, and comes from "The Junction" between Queenstown and Molteno, it represents the other form; the broad end has a sharp edge, and was evidently designed for chopping. Such axes may have been held in the hand, for in some examples care has been taken to batter the sharp edges where they would come in contact with the hand in holding the stone.

One unique specimen is shewn in Fig. 22; it is of highly indurated silicious sandstone of dull greenish colour, and was found by myself in the main kloof of "Maynard's Hoek," Camdeboo; it differs from any other specimen I have seen in having both faces near the cutting edge slightly ground, it also shews proofs of long-continued use, for notches in the edge that could not have been ground are smooth from friction. Had there been an urgent need for hatchets among the aborigines of South Africa, such as existed in the case of the Australian blacks, it is highly probable that better shaped, more highly finished types would have been manufactured; their absence would countenance the view that this country has been destitute of forest since its occupation by man. It would be of great interest to ascertain if better axes were used in the tracts of country where forests exist.

Axes are found of both types on the Cape Flats and also inland. The broad-edged type was most likely found of service in severing the limbs of game, and in some cases for cutting wood.

Flat stones for grinding on.

Mealing stones are among the commonest of relics left us by the preceding inhabitants: unlike most of the others they are not confined to the yellow-skinned races, but the forms of those used by Kafirs differ on the whole from the Bushman and Hottentot type.

A slab of sandstone or dolerite is generally selected, the depressions on each side sometimes have met, and the stone as a consequence has been rendered useless; especially is this the case with Kafir mealing stones, the Bushmen or Hottentots seldom had enough grinding to do, to wear out the stones.

On the Cape Flats, many of the mealing stones are unusually small, some not more than 8 inches long, and about half as broad; such small examples are generally formed from a flat pebble procured from the neighbouring shingle beach, they are most numerous in the vicinity of the old dwelling-places of the former inhabitants.

In the Stormberg district, small slabs of stone are common with one or both sides abraded, suggesting the use to which they have been put; very rarely are they worn into troughs.

In the Camdeboo, along the valleys such stones are plentiful; they are turned up in ploughing and thrown outside the ploughed spaces by the farmers; most are of sandstone, some are trough-like, but more have concavities with diameter equal in every direction. In Bushmanland, I have observed that bosses of gneiss, especially where in isolated positions they protrude through the sand, have been utilized by the Bushmen, and slight hollows or abraded surfaces shew where grinding operations have been carried on; about the bases of some of the bosses such places are numerous, as for instance Leeuwe Klip. The Bushmen obtained stores of grass seeds by robbing ants' nests, they ground them, cleaned away the husks, and prepared them for food by boiling to a sort of porridge in their clay pots.

Another article of food with the Bushmen consisted of locusts; these were roasted in the fire and then ground to a paste and mixed with fat, forming a delicacy that was greedily devoured.

The Kafir mealing stones are much larger than the preceding; they are from 18 to 24 inches long, and from 12 to 15 inches broad, and 3 to 6 inches thick: hard sandstone or dolerite are preferred for the purpose, they are often deeply worn. The Kafir women kneel at one end of the slab, and taking the large muller in both hands, they lean over the mealing stone so as to throw weight on the muller, which is moved backwards and forwards, at the same time a rolling motion is imparted to the muller by a movement of the wrists. These mealing stones are used for grinding maize and millet, also for making snuff; they are to be seen at every Kafir kraal; whole and broken examples are met with wherever old kraals have existed. In the valley of Steelport River, near the Cobalt Mine, Transvaal Territory, ruined kraals built of magnetite abound, they were occupied by the older tribes of Kafirs or Macattees who fell a prey to the incursions of the later Zulu tribes, as they pressed down from the north; about these old kraals are

great numbers of mealing stones. In the valley of Sand River just to the south of Spitz Kop, Gold Fields, Transvaal, these stones also abound. These mealing stones are of peculiar interest, as they appear to be almost universal; examples found in Europe are precisely such as are found in South Africa: no doubt such simple implements for grinding preceded the use of querns &c. in every country.

Mullers or Grinders.

Small hand grinders are as widely disseminated as the mealing stones, being equally indispensable; they are generally formed of the hardest stone within reach, often they are pebbles ground on the side, or where dolerite in a decomposing state occurs a small undecayed nodule is thus applied. The grinding faces of these mullers are seldom flat, they are generally convex, often saddle-shaped.

A peculiarity observable on those from the Cape Flats, and absent on the Stormberg and other inland specimens, is that the centre of the grinding face has a slight hollow picked in such a manner that the substance to be ground would be retained; in fact this was the operation represented by the grooving of mill-stones as now employed. Mullers such as Fig. 20, from "Witte Kop," Stormberg, were held between the points of the fingers and the ball of the thumb in grinding. Long forms such as Fig. 21, from "Streep Fontein," Stormberg, were held as a pestle would be, and were most probably used for grinding up the colours with which they painted themselves, and the figures on the rocks; only some colours would have been ground thus, for in the case of red, I have several small pieces of red hematite that have been ground on another piece of stone, and one small palette of sandstone shewing considerable use. The grinding face of the long implements is always oblique to the longer axis of the stone, for they are more comfortably worked when slightly inclined than when held vertically.

Long rolled pebbles from the beach of Table Bay, the ends of which are bruised or ground, proving them to have been used as mullers, are numerous on the Cape Flats.

The Kafir muller is formed of a piece of sandstone or dolerite from five to eight inches long, half as broad, and slightly tapering at either end. The grinding face is somewhat convex, and is generally roughened by picking; in use the longer axis of the muller is at right angles to the longer axis of the mealing stone.

Rubbers.

Flat pieces of soft sharp sandstone, three to five inches long and two to three inches broad by about one inch thick, having

a convex surface on one side, similar to Fig. 19, are of frequent occurrence in the Stormberg District, and elsewhere. The material as well as the shape render it highly improbable that such stones were used as mullers for grinding food, it is far more probable that they were used for dressing skins, for in such an elevated region as that of the Stormberg, it is not likely that the Bushmen endured the cold without some kind of dress. These implements are found around the old dwelling-places under the steep ledges of rock.

Arrow-straighteners.

Wherever Bushmen have been known to live, implements of stone for straightening the reeds used for arrow-shafts are met with; they are still to be found in the kit of most Bushmen in Bushmanland. Frequently they are formed of a small pebble, or are shaped like one as in Fig. 27, from "Leeuwe Fontein," Stormberg. The material in this case is dolerite, others are formed of quartz-rock or sandstone, and rarely steatite is employed.

On one side a groove is cut, as represented in the illustration.

Fig. 26 is of quartz-rock, it is from "Vreede," Camdeboo: less shapely pieces of stone are grooved and used as straighteners, and it is no uncommon thing to find the same stone serving as a straightener, a muller and a hammer, among the remnants of the Bushmen along the Orange River.

The groove appears to have been formed by first picking along the line intended, and afterwards grinding it smooth by means of a piece of sandstone.

No instance of such a grooved stone has been observed on the Cape Flats.

These stones are used by first heating them in the fire, and then rubbing the fresh-cut reed along the groove until it is rendered sufficiently straight; the groove is frequently quite polished from this operation.

Perforated Stones.

Stones of spherical form and perforated occur throughout South Africa, they vary in size from a little more than one inch up to more than seven inches in diameter. The larger specimens weigh seven to eight lbs. Though spherical forms such as Fig. 31, which is of sandstone picked into shape, and from "Kust," Camdeboo, are most common; there are many divergences from what may be considered this normal type. On the Cape Flats and elsewhere irregular pebbles have been found with a hole drilled through them. In Bushmanland very irregular forms are met with. A ient of a small perforated disc of sandstone neatly ground and han half an inch thick, is from "Klip Font," Stormberg

(Fig. 29). Fig. 30 represents a disc of hard sandstone, a little under one inch thick, from "Lange Font," Camdeboo. Fig. 25, from "Van der Walt's Kloof," Camdeboo, was also probably intended for a perforated stone.

Another form of perforated stone of rarer occurrence, is quoit-shaped, generally of soft slaty rock; they were perhaps worn as armlets, judging from the size of the hole.

Besides the previously specified rocks, many varieties of sandstone, shale, dolerite, limestone, &c. were employed in making the perforated stones.

Where nodules exist, as in some sandstones and dolerites, the nodules were availed of, at other times pebbles answered the purpose, or rough pieces of rock were used and dressed into shape.

From many examples observed in various stages of finish, it appears that when a suitable nodule or block for a spherical stone was secured, it was picked over the surface with a sharp-pointed stone, until of the desired form and size. The hole was then commenced from opposite sides, and also picked out by means of pointed stones. (The marks of the implement, in one example of an unfinished stone from "Schiet Fontein," Graaff Reinet Railway, prove the worker to have been right-handed.) As the holes deepened, more slender picks were required, and once the holes met, the work of enlarging was accomplished by means of such tools as are figured as borers or rimers, and the finish imparted by the use of slender files of sandstone. Some holes are nearly cylindrical, but all digging-stones bear more or less evidence of the hole having been commenced from opposite sides. The holes are from $\frac{3}{4}$ to $1\frac{1}{2}$ inch in diameter. No ornamentation has been observed on any specimen. Fine grooves sometimes occur, caused by the sharpening of tinned plate arrow-heads on them.

The examples from the Stormberg—where the users are known to have been the small Bushmen—are conspicuously smaller than those generally met with.

So far as the common forms are concerned, there is little difficulty in comprehending the uses of such perforated stones, for they are still employed by the Bushwomen, in Bushmanland, as make-weights for their digging-sticks; they insert a straight stick about one inch thick and from three to four feet long—the point of which has been sharpened and hardened in the fire, or else shod with a straightened spring-bok horn—for half its length through the perforated stone, a small piece of stick is driven into the hole on the under side of the stone acting as a wedge and preventing the stone from slipping down when a blow is struck. This implement is grasped by one hand above the stone, and by the other below, and as a digging tool for uprooting "numtjes" and "camberoo," it would be difficult to devise a

better without the use of metal. When the gems-bok was more plentiful, one of the horns was inserted instead of a stick.

Such implements must have been, as they now are, almost indispensable to a race like the Bushmen, who depend to a considerable extent for their sustenance on the roots gathered in the field.

That these perforated stones were made by the Bushmen or rather women, there is every reason for believing, for in the Stormberg, where considerable mounds of débris are found in front of rock shelters they inhabited, these stones are found occurring with the implements used in their manufacture; the implements are frequently broken, implying that the work of perforating the stones was carried on where the pieces are found.

An opinion is held by some that the Bushmen utilize these digging-stones but are not the makers; there appears no good ground for this view, which has probably originated in the fact that they are not manufactured *now;* but the Bushmen are so reduced in numbers, and such stones are so abundant, that there exists no necessity for making fresh ones. The knowledge of the manner in which they are made, however, remains; for the same old Bushwoman that shewed me the manner of affixing stone flakes to arrow-shafts, described the method and particularly mentioned the long pointed stones of hard material, which she said were obtained from the Kiljan Veldt. Stones suitable for the purpose do occur there, and since then I have found in the Stormberg numbers of rimers answering her description. Besides, there is no evidence that any other race preceded Bushmen in South Africa.

It is evident from their size, that all perforated stones were not used as make-weights for digging-sticks. Some of the small ones are smoothly ground and may have been used as ornaments or as toys. I have met with small polished stone hatchets in Australia that in form and material were the counterpart of the larger ordinary weapons, but too minute to be of any practical use for chopping.

The Hottentots no doubt also used these perforated stones.

III. *On the Languages of the Mozambique and of the South of Africa in their relation to the Languages of Australia**. By HYDE CLARKE, Vice-Pres. Anthropological Institute; Vice-Pres. Statistical Society; Vice-Pres. Society of Arts; Corr. Mem. American

* This has been printed by the Royal Society of Victoria (read, Nov. 13, 1879). "On the Yarra Dialect and the Languages of Australia in connection with those of the Mozambique and Portuguese Africa" is the title there given.

Oriental Society; Mem. German Oriental Society; Hon. Mem. American Anthropological Institute; Hon. Mem. Byzantine Society of Constantinople; Mem. Academy of Anatolia; Corr. Mem. Ethnographic Society of Paris; Corr. Mem. Congress of Prehistoric Archæology; Fellow of the Royal Society of Antiquaries of the North of Copenhagen; Fellow of the Philological Society; Fellow of the Royal Colonial Institute.

[Read Sept. 30, 1879.]

In Mr R. Brough Smyth's great work—*The Aborigines of Australia* (Melbourne, 1878)—there will be found in the second volume much matter on the languages of Australia. Among these will be found a very long vocabulary of the Yarra dialect of the Yarra river of Melbourne, composed by Mr John Green, Inspector of Aborigines.

Unfortunately many common words are left out, so that comparison can only be imperfect. However, I found on examination that it compares directly with a body of languages in Portuguese Africa, being Class XI. of Koelle's Polyglotta Africana and comprising Muntu, Kiriman, Marawi, Meto, Matatan, and Nyamban, being the languages of Mozambique. The words outside of Class XI. are found in Class X., being Bantu or Kaffir Languages of Portuguese Western and Central Africa, being Congo, &c. Some words are found in Class IV. which is related to Class X.

The following list will shew this, the Class X. words being thus marked [ ].

	YARRA.	AFRICA.
Man.	kolin (koli)	[akala, Muzentandu]
Woman.	bagarrook	[baketo, Nyombe]
	bajor	[badshento, Kabenda]
Daughter.	munggip	moanaka
Father.	marmun	(mama, *mother*)
Mother.	baboop	(baba, *father*)
Brother.	banggan'noo	pangiandenge
Sister.	latingata	ndengetu
Eye.	mee, merring	meso
Tooth.	leeang	leeno
Navel.	moondok	matoku
Knee.	barreng	bondo
Bone.	ma-lingo	likuwa
Skin.	morrok	[mungoto, Lubalo]
Beak.	barrgin-boon	poono
Knife.	kal-been	mu-kalo mbene
Axe.	karrgeen	koangoa
Spear.	goeeon	[ngaya, Lubalo]
Stone.	moojerr	moara

	YARRA.	AFRICA.
Coal.	kanendurr	kala
Rope.	woodel	[wondi, Mbamba]
Stick.	kalk	[koko, Kabenda]
Leaf.	jerraug	[jish, Bumbete]
Yam.	barrm	[mbala, Kabenda]
Cat.	bede-dil	[budi, Mimboma]
Musquito.	gogook	[ngomgu, Mbamba]
Lizard.	tourroop	tabarrada
Little.	wy-krook	[watola, Kasanj] to-kiege, Bumbete
White.	lam-borreen	[a-pfurau]
Black.	woo-gar-ring	woo-ripa
Young.	boop	[biop, Kanyika]
Warm.	loom-bodin	[a-domu, Melon]
Go.	yani	[yami, Lubalo]
Come.	wandeat	uta
Cough.	kooningoon	[ekona, Orungu]
Die.	wykit	ukoa
War.	ngatang	ngondo koto
Sun.	ngumi	[ekombi, Pangela] [ukima, *moon*, Lubalo]
Moon.	meene-an	[moanya, *sun*, Lubalo]
Sky.	woorwarra	wa moluku
Day.	karremeen	[muini, Musentandu]
Night.	boorren	[buila, Kabenda]
Rain.	al	epula
Dew.	warrong	[ewuru, Sobo]
Fall.	baderin	[buidi, Kabenda]
Sit.	ngalimbe	kala
Dream.	yiook-gen	gona
Give.	woonga	wunya
Cut.	bundi	[batura, Kasanj]
Catch.	banga-yat	[guata, Kasanj]
Two.	bollo-ween	beli, peli

To the Yarra model belong Kabi, Gunbower, Tyntyndyer, Glenorchy, Horsham, Upper Richardson, Balmoral, Hamilton, Wickliffe, Avoca, Daylesford, Goulburn, Witouro, Iajowroug, Kuen-Koren-werro, Burapper, Ta-ounguroug, &c.

As a further test, beyond the one Mozambique language answering to the Yarra, if we take other Australian roots we shall find their correspondents in the other languages of the Mozambique. Thus five roots for Man and three for Hair admit of being so compared.

The Echuca, Morcovia, and Sandford particularly shew this, and the results are obtained from Moreton Bay in North Australia, New South Wales in the East, and from Western Australia.

The following table illustrates this:—

	Australia.		Kiriman, &c.	Africa.
Man.	Echuca	moanit	moanna	Marawi
	Yelta	maalee	mulo	Kiriman
	Morcovia	nunna	nona	Nyamban
	Balmoral	beng	boana	Marawi
Head.	Gunbower	moorun	muru	Kiriman
Hair.	Wickliffe	marah	murit	Kiriman
	Yarra	yarre	ikarare	Muntu
	Gippsland	leet	lefu	Mutsaya
	Echuca	boka	[mbeta	Kisama]
Ear.	Echuca	marrmo	maro	Matatan
	Yarra	wooring	nyaru	Marawi
Tooth.	Echuca	derra	dino	Nyamban
	Sandford	tungung		
	Yarra	leeang	leeno	Marawi
Mouth.	Sandford	mullong	malagu	Meto
	Morcovia	moun	[munua	Kabenda]
	Hamilton	kone	[li-kano	Lubalo]
Sun.	Bulloo	tuni	etana	Muntu, *day*
			[tangu	Kabenda]
	Yarra	ngume	[ekombi	Pangela]
Two.	Moreton Bay	bullae	beli	Kiriman
	Yarra	bollo-ween	peli	Kiriman
	N. S. Wales	pulla		
One.	Victoria	ngie	ni	Muntu
		ngan	ne	Nyamban
	S. Australia	ngu		

It is very seldom that we can so distinctly lay down languages which are really related, but widely distributed. There is therefore no mistake that the language of the Melbourne tribes is of common origin with those of Mozambique.

A curious circumstance will be noticed, that though the words may differ internally they commonly begin with the same consonants in both continents. This serves to mark them, for in the class of languages to which they belong, the Bantu or Kaffre, the initial syllable is of great import.

This brings us direct to papers of the great authority on the Bantu languages, the late Dr W. H. Bleek, contributed by him at the request of Professor Huxley to the Anthropological Society and Institute, and to be found in Vol. I. of the *Journal of the Anthropological Institute.*

From the consideration of the grammatical points Dr Bleek was fully convinced that the Australian languages were related to the Bantu, and this he develops in a most remarkable paper on general philology.

Here too he examines what another great comparative

philologist Bishop Caldwell had done in the Comparative Grammar of the Dravidian Languages, as to the wonderful identity of the Australian first personal pronoun with the Dravidian and some other Indian languages. Caldwell was however unable to trace detailed resemblances. The observations of Dr Caldwell are however as worthy of careful perusal as those of Dr Bleek.

The latter was near seizing the whole truth as to the Australian languages, but missed, first from devotion to a theory he had laid down of sex-denoting languages, as a type for classification. Next he failed from the besetting mania of philologists of regarding chiefly grammatical forms, and disregarding words.

Were it not for these circumstances Dr Bleek with his intimate knowledge of the Bantu family must have identified the facts here given. Strangely enough, in the same volume of the Anthropological Journal is a paper and comparative table of Australian Languages by the Rev. Geo. Taplin, which contain the words.

Dr Bleek recognized the connexion of mythology with language, and the fact that the mythology of Australia is related to that of other regions.

The practices and culture of Australia are well enough known to present many features in common with those of the rest of the world, and the relation of an Australian mummy was only a few weeks ago illustrated by Professor W. H. Flower at the Anthropological Institute.

In order to explain the ground on which the observations of Dr Caldwell and Dr Bleek rest, it may be useful to refer to those which were made by me on the 22 Nov. 1870 (*Journal*, p. LXXXIX.). It results from the course of inquiry then instituted by me that the Australian belong to a group of languages (and in this term I conform with Dr Bleek) to which also belong the Bantu and the Dravidian.

These languages, although developed in common and from the same sources, constitute a group. Thus the result is that roots may be differently selected in Australian, Bantu and Dravidian, and will not fit in together in each case, notwithstanding their common origin. The resemblance between the Yarra languages and the Mozambique languages is, as already stated, much closer than is commonly found.

It has been the opinion of some distinguished anthropologists that Australia is a centre of the human race, from which India and Africa were peopled. However this may be, the facts now brought forward are, so far as language is concerned, in proof of the direct contrary. Africa, so far as this evidence is concerned, is the great centre of languages, of mythology, and of civilization.

As in another paper contributed by me, High Africa has been treated on as a centre of culture, it is not necessary to go into the whole subject here.

The Australian languages will be found to belong to one of the earliest epochs of development of language in this group, but I am of opinion that the testimonies brought forward in Mr Brough Smyth's work, as to Australia having been at some former period under the influence of a white race, are correct.

As such, I should class, which I cannot now account for, though I have an hypothesis not yet tested, the curious circumstance that the names of languages in Australia are negatives. Now, a whole section in my *Prehistoric and Protohistoric Comparative Philology and Mythology* is devoted to the exemplification of this remarkable characteristic of a negative series. Now one language is called the Kabi, and Kaba figures largely in many languages of the old world as a negative.

Mr R. Brough Smyth in *The Aborigines of Victoria*, Vol. II. page 8 (Trübner, 1878) says:—

"A great many of the languages of Australia are named after the word 'no.' The late Mr Bunce states that the Melbourne people used, to designate their language, the words N'uther Galla—N'uther meaning 'no.'

"The late Mr E. S. Parker corroborates Mr Bunce's statement. He says: 'The natives distinguish the different talk or languages by their negations. Thus there is the Burapper dialect, spoken by the Mallegoondeet; the Utar dialect, on the Murray, and Lower Goulburn—these words, Burapper and Utar, being respectively the negations of each language; and so of others.'

"This system of nomenclature appears to prevail in the eastern and southern parts of the continent.

"The Rev. W. Ridley, M.A., eminent amongst the philologists of Australia, says the following are the names of some languages spoken in the interior:—1. Kamilaroi; 2. Wolaroi; 3. Wiraiaroi; 4. Wailwun; 5. Kogai; 6. Pikumbul; 7. Paiamba; 8. Kiugi;—the first five of these are named after their negatives. In the first Kamil signifies 'no'; in the second Wol is 'no'; in the third Wira is 'no'; in the fourth Wail is 'no'; in the fifth Ko is 'no'. In Pikumbul on the other hand Piku means 'yes'."

Indeed the whole evidence is in confirmation of what has been stated by me (*Prehistoric Comparative Philology and Mythology*, London, Trübner) that under the doctrine of the Four Worlds taught in the School of Pergamos the ancients preserved a knowledge of what was known to their predecessors in Babylon. The Austral world, which in the globe balanced our world, was Australasia, as in the other hemisphere the North and South Worlds were North and South America.

Thus the knowledge of this intercourse was long lost, until now we can restore a passage of many thousands of years old in the history of Australia.

IV. *Critique on Mr Hyde Clarke's Theory of the Relation of the Australian to the South African (Bantu) Languages.* By THEOPHILUS HAHN, Ph. D.

[Read Oct. 29, 1879.]

In the last meeting of this Society, a paper from Mr Hyde Clarke was read "On the Languages of the Mozambique and of the South of Africa in their relation to the Languages of Australia."

As many of the gentlemen now present had not the opportunity of hearing this paper, I shall repeat its main points.

The very title is misleading. To speak in the style of Mr Hyde Clarke, we might say: "On the Languages of England and those of the Indo-European Family and their Relation to the Semitic;" just as if the language of England, with its dialects, does not belong to the Indo-European family.

Mr Hyde Clarke says "that the South African and Mozambique languages are related to the languages of Australia." He bases his arguments chiefly on very superficial resemblances between some seventy words, picked indiscriminately from various Australian languages, and words from the languages of the South African class.

I have carefully gone over Mr Hyde Clarke's paper, and speaking advisedly I am convinced that he is not familiar with the method of Comparative Philology in general, and that his knowledge of the African, Australian and Dravidian languages is exceedingly limited.

The two chief rules which in all comparative processes must be observed, are:

(1) "That comparisons must have in view the established lines of genetic connection."

(2) "That the comparer must be equally versed in the materials of both sides of the comparison." (Whitney.)

Against both laws Mr Hyde Clarke has gravely sinned. Before he ventured to institute etymological comparisons he ought to have convinced us of the coincidence of the main features in the Bantu and Australian languages.

Both classes of languages belong *morphologically* to the *agglutinative* class, that is, a word may consist of diverse elements, of which one part, the root, alone contains the leading idea, the main thought or conception, and to this root or substance other formative elements are applied, by prefixing or suffixing, moulding the substance of the root into various shapes. A few examples will illustrate this explanation.

Khoi in Hottentot is the root of *man*; from this root we can

form the following derivatives: khoi-b, *the man*, khoi-s, *the woman*, khoi-gu, *the men*, khoi-ti, *the women*. Khoi-si, adj. a new base, from this khoi-si-s, *humanity;* by applying new suffixes khoi-si-ga-gu, we have *to be friendly towards each other*, and from this by suffixing the sex-denoting particle *s*, we have again khoi-si-ga-gu-s, *friendship, husbandry*.

Or in Turkish köpek, *dog*, sing., köpekler, plur. *dogs;* Selim, nom. propr. masc., Selim-a, nom. propr. fem.; et, *meat, flesh*, etli, *fleshy*; akyl, *reason*, akylli, *clever*, i.e. *full of reason*.

What in these languages is expressed by suffixes, the Bantu and Polynesian languages express by prefixes.

This agglutinating or agglomerating process is all the South African and Australian languages can be said to have in common. *The mode of agglutinating however in the one is totally different from that in the other;* the South African or Bantu languages being Prefix-pronominal languages, while the Australian are strictly Suffix-languages.

I shall now give a short sketch of the characteristics of each class of language, which will put the striking difference between the two at once into bold relief.

In the Australian languages the Phonology is very simple. There are five vowels, and also five diphthongs; but these latter are not diphthongs in the true sense of the word, but merely loose combinations of vowels. The consonants are only eleven, and we miss the mediae *b, g, d*, the sibilants *s* and *z*, the spirants *f* and *v*, and the aspirate *h* (according to Hall, U. S. Expl.).

Almost every word commences with a consonant, and three-fifths of the words end with a consonant, generally *l, r*, or a nasal *ng*. Kulang, *child;* mammul, *son*.

The accent rests on the penultimate.

Let us now compare the Phonology of the Bantu languages.

All the Bantu idioms have the three radical vowels, *a, i, u*; *e* and *o* in most cases prove to be contractions of $a+i$ and $a+u$. There are seven diphthongs, two more than in the Australian languages. The Bantu besides are very rich in consonants, showing an average of twenty-five, and *those wanting in the Australian, are in Bantu the chief phonetic components of words.*

There is in Bantu a strong inclination to commence the words with vowels which may clearly be observed in those dialects, which preserved most distinctly the original features of the primitive Bantu. On account of having the accent generally on the ultimate or penultimate, the vowel in the commencement (Anlaut) has dropped.

Every word in Bantu ends in a vowel (Auslaut vocalisch); where a consonant now occurs the previous existence of a vowel can be proved.

It must also be mentioned that all verbal roots end in *a*, for instance:

Kafir,	tand*a*,	*to love*
Suaheli,	pat*a*,	*to reach*
Herero,	hungir*a*,	*to speak*
Tsuana,	rat*a*,	*to love.*

The Australian languages do not show such peculiarities, but their verbs frequently end in consonants as well as in vowels:

taarcung, *to bend*	kuraaku, *to kick*
burnt, *to fish*	pygi, *to rise*
yeung, *to hold*	kero, *to pluck*
wakka, *to be.*	

So much as regards the phonetic appearance of the words.

Both languages, it is true, agree in having no gender; but the Bantu languages have a most efficient substitute for the article, the pronominal prefix, which divides the substantive into various classes.

Again, the Australian languages have no plural or dual. Makoro means *fish* and *fishes*; tulun means *mouse* and *mice*; tipin means *bird* and *birds*, etc., etc.

In very few instances for words which mean human beings, a plural has been established (vide Grey's *Vocabulary*).

A similar instance we have in the dialect of the Kham-Bushman language, on the northern border of our colony.

The South African languages on the other hand clearly distinguish a singular, a plural, and a collective by the means of prefixes. As a rule, words in Bantu are modified, not by suffixing, but by prefixing the various elements of modification, in order to form new bases from the roots, while the Australian languages are strictly suffixing, so strictly indeed, that even our prepositions are expressed by post-positions. In Bantu also all prefixes are of a pronominal nature, while this cannot be said of the suffixes in the Australian idioms.

I said as a rule the Bantu languages are prefix languages, and these prefixes are of a pronominal nature. But I also will mention, that to form new bases of substantives or verbal roots they apply also suffixes. But these suffixes do not appear to be of a pronominal nature, but seem to be of a strictly nominal character, so that the new bases formed by the application of suffixes, are derivatives of nominal elements.

Kafir, tenga, *to trade*	umteng-i, *the trader*
„ kala, *to call*	isi-kal-o, *the call*
„ in-kosi, *the chief*	in-kos-azana, *the chief's daughter*
„ hamba, *to go*	hamb-ela, *to attack*
„ tanda, *to love*	tand-ana, *to love each other* (*mutually*).

In the Australian languages also new bases of words are formed by suffixing certain particles and elements, whose true nature and origin is very dubious. Some appear to be crystallised post-positional elements, others to be obtruncated nominal elements of a collective nature, very few again seem to be pronominal. The modification of words is affected by suffixes; and we should expect, as they have to perform a task similar to that of the Bantu prefixes, they also should be of a pronominal nature. This however, as stated, is not the case.

Another significant feature in the Bantu is that every adjective stands in the position of a suffix to its substantive, adopting at the same time the prefix of the substantive.

Herero: omu-ndu, omu-nene; the man, the big one.

This is not the case in the Australian. If a word adopts suffixes, employed for the modification of substantives, it becomes at once a substantive.

It must also be mentioned that the Bantu idioms are not very prolific in adjective roots, and they, to supply this want, express adjectives or adjective meanings by a substantive with a preposition. *The beautiful girl* is expressed, *the girl with beauty.* The clever man, *the man with cleverness.*

The Bantu languages throughout express the various cases by pronominal particles or prepositions, but these cases, of which for instance the Macquarie dialect in Australia has *ten*, are expressed strictly by suffixes.

We come now to the numerals.

The Bantu languages show the same root all over, and consequently the same system of counting. It is the so-called *quinal* system.

	Kafir.	Herero.	Suaheli.
1.	i-nye	mue	m-moga
2.	zi-mbini	vari	m-bili
3.	zin-tatu	tatu	tatu
4.	zi-ne	ne	n-ne
5.	zin-hlanu	tano	tano
6.	zin-tandatu	hamboumue	setta
7.	zi-ten ē	hambombari	sabaa
8.	zi-mbo o	hambontatu	nane.
		&c.	

From "one" to "five" the common origin is quite clear, but from "six" to "ten" in some languages the original roots seem to have been lost and replaced by new forms, especially from the neighbours with whom they came into commercial contact (vide the Kisuaheli).

The Australian languages have not developed beyond four, many even, as our Bushmen, not beyond two.

Need I say, that the pronominal elements in the Bantu show a variety unsurpassed almost in any other language in the world, and that the Australian languages can in this respect not compare with them?

I might speak for another hour were I to draw only a comparative sketch of the Bantu and Australian verb. One thing however is so peculiar to the Australian languages, that I find no analogy to it in any other class of human speech: it is the mode of forming the passive. The person in passive who is the sufferer is expressed in the accusative and not in the nominative. Me is beaten, says the Australian, not I am beaten—or to express it more distinctly: "While the active is formed by putting the pronoun of the verb *before the verb*, the passive is formed by suffixing the objective form of the verbal pronoun to an impersonal form of the verb." (Friedr. Müller's *Sprachwissenschaft.*)

So much on the morphological difference of the two classes of languages. Morphological relationship is entirely out of the question, and consequently we dare not venture on etymological comparison. But to do justice to Mr Hyde Clarke, I have taken the trouble to look all the words up produced by him and to analyze them: but I regret to say that not one single word could stand the test. The following analysis must speak for itself. It will convince everyone, that Mr Hyde Clarke's strongest point of argument, the resemblance in the initials of the words, fades like snow before a tropical sun, as soon as it is examined by the method of linguistic anatomy.

Man.	AUSTRAL., Yarra	kdiu (kola)
	AFRICA, Umsentandu,	a kola.

Mr Hyde Clarke should, before giving this word akala, have compared the word for *man* in all the other Bantu dialects, and he would have found that akala is a dilapidated form, originally being babalaka, the first *ba* being prefix plur. and balaka the radix. I have already stated the tendency in Bantu phonology to drop the initial on account of the accent being on the ultimate or penultimate.

Woman.	AUSTRAL., Yarra,	bagarrook, bajor
	AFRICAN, Ngombe,	baketo
	„ Kabenda,	badshento.

In Yarra the root is bagarrook or bajor, so that the initial syllable ba forms an essential phonetic component of the root, and if omitted may involve a similar change in meaning, as if in German from the word *b*engel (ruffian) the initial *b* were struck off, and we had the word engel (angel); but the Bantu word is according to Koelle

n-dsento sing. ba-dsento plur.

n and *ba* being the prefixes and dsento the root, which latter cannot be compared with bagarrook or bajor. The same argument applies to ba-keto and bajoor, where in ba-keto ba is prefix and keto the root.

Daughter.	AUSTRAL., Yarra,	munggip
	AFRICAN, Meto,	moanaka

The Bantu (Afr.) root is anaka, and mo is the prefix sing. Therefore a comparison between anaka and munggip is impossible.

Father.	AUSTRAL., Yarra,	marmun
	AFRICAN,	mama (*mother*)
Mother.	AUSTRAL., Yarra,	baboop
	AFRICAN,	baba (*father*)

On such arbitrary comparisons of words comment is surely unnecessary.

Brother.	AUSTRAL., Yarra,	banggannoo
	AFRICAN, Lubalo,	pangiandenge

Here according to Hyde Clarke the Yarra word for brother consists of a simplex, while the Lubalo word (*vide* Koelle) is a derivative or composite, consisting of the two nominal roots, pangi and ndenge. The sister dialects of the Lubalo show the following forms:

Musentandu,	pangi	Basundo,	panki
Kasands,	pandsi	Songo,	panget
Ngombe,	pantsi		

and the Lubalo form *denge* is in

Ngola, denk Kisama, ndengetu;

in the latter form no doubt *n* in ndeng is an obliterated prefix.

Sister.	AUSTRAL., Yarra,	latingata
	AFRICAN,	ndengetu

Here Mr Hyde Clarke has not been very careful in quoting. In the whole of Class x. under the heading *younger sister* there is only in the Kisama dialect the form ndengetu to be found, but with the addition of diaumhettu. Now this ndengetu at very first sight shows its kinship with ndengetu (Kisama), denk (Ngola) and denge in pangiandenge (*vide* Koelle x. *sub* "younger brother"). I have already stated, that denge in pangiandenge had nothing to do with the Yarra word bang for *brother*, and certainly the same bang has nothing to do with latingata, *sister*.

Eye.	AUSTRAL., Yarra,	mee merring
	AFRICAN,	[meso]

Here again (*vide* Koelle) me-so is the plural form of the singular di-so, me and di being prefixes and so being the radix; therefore so (Afr.) and merring (Austral.) cannot be compared together. If we would follow Hyde Clarke's method, we may compare Hottentot (Namaqua) mu-s with Bantu meso. In ama ‖ osa, Kafir, we have the same root so, with the fuller prefix ili, ili-so.

Tooth.	AUSTRAL., Yarra,	leeang
	AFRICAN,	leeno (H.C.)

Our author here has commited forgery!

The African word given by Koelle is li-no; why write it leeno? (*vide* Koelle, Class XI.) *li* prefix and *no* root; therefore no and leeang cannot be compared together; for Ama ‖ osa we izi-nyo.

Navel.	AUSTRAL., Yarra,	moondok
	AFRICAN,	mutoku

Need I say that mu is prefix and toku radix, which does not allow itself to be compared with moondok?

Knee.	AUSTRAL., Yarra,	barreng
	AFRICAN,	bondo

The same mistake as before. In the Maravi (*vide* Koelle, *sub* "knee" Class XI.) bondo very likely originated from bo-ondo, as the plural shows ma-ondo; in Nyamban d-ondu, plur. ma-dondu, therefore b or bo prefix sing. and ondo or ndo or ndondo have nothing to do with barreng.

Bone.	AUSTRAL., Yarra,	malingo
	AFRICAN, Kiriman,	li-kuwa

Radix kuwa and li prefix; therefore kuwa cannot be compared with malingo. Compare also in Matatan sing. ne-kuwa, plur. ma-kuwa.

Skin.	AUSTRAL., Yarra,	morrok
	AFRICAN, Lubalo,	mungoto

Mu in the African word is prefix and ngoto radix, which cannot possibly be compared with the Australian morrok. *Vide* in Kisama, sing. mu-nkot, plur. mi-nkot.

Beak.	AUSTRAL., Yarra,	baargin-boon
	AFRICAN,	poono

I have searched in vain in Koelle's *Polyglot* for the word *Beak*, perhaps our author means *Buck*; if so we must remind him that Australia has no bucks or goats, and that these animals have been imported by Europeans. Therefore baargin is a word of a later date and admits no comparison with the African word.

Knife.	AUSTRAL., Yarra,	kalbeen
	AFRICAN,	mu-kalo
		m-bene

From a comparison with the Nyamban word in Koelle, it is obvious that kalo is the root and mu prefix sing. In Nyamban n-kala sing., me-kala plur.; in m-bene, plur. mim-bene, m and mim are prefixes and bene radix.

Axe.	AUSTRAL., Yarra,	karrgeen
	AFRICAN, Marawi,	koangoa

As can be seen from the plural of koangoa the original form must have been nkoan-goa, and this form is nothing but a reduplication of the form nkoa. Compare also in Kikama, de-koa sing. plur. ma-koa; or Lubalo, nyanga sing. manyanga plur. Where in this instance resemblance exists between the Australian and African word, is not quite clear.

Spear.	AUSTRAL., Yarra,	goeeon
	AFRICAN, Lubalo,	ngaya

In the African word n is prefix and gaya is radix; but we might just as well compare Hottentot goab with the Lubalo gaya.

Stone.	AUSTRAL., Yarra,	moojerr
	AFRICAN,	mo-ara

It appears that Mr Hyde Clarke has given the Marawi singular form. From a comparison with the plural mi-ara, he might have seen that ara is radix and mo prefix. This ara however is an obliterated form which, as a comparison of the dialects in Classes X. and XI. shows, had a fuller primitive form, tali, tadi or tari, which cannot be compared with moojerr.

Rope.	AUSTRAL., Yarra,	woodel
	AFRICAN, Mbamba	wondi

Koelle gives for the sing. wondi, the plur. endi, leaving consequently ndi as root, and wo and e as prefixes. Therefore comparison is out of question.

Stick.	AUSTRAL., Yarra,	kalk
	AFRICAN, Kabenda,	koko

The African word is formed by reduplication and does not simply mean a *stick* but a *walking-stick;* the original radix therefore is Ko or Ka. The Austral. kalk ends in a consonant, which, as already stated, is not the case with Bantu words.

Coal. AUSTRAL., Yarra, kanendurr
AFRICAN, Ngombe, Basunde, Marawi } kala

Why not rather compare the African word with our *coal*?

Leaf. AUSTRAL., Yarra, jerrang
AFRICAN, Bumbete, jish

Anybody acquainted with Bantu knows that no Bantu word ends with *sh*; but Mr Hyde Clarke gives jish, while the authority he quotes (Koelle, Class X. *sub* "leaf") gives in Bumbete, dsues, which originally was either dsuesa or dsuesu. It is very painful to think that our author again should have quoted from Koelle, what never was meant by him.

Yam. AUSTRAL., Yarra, barrm
AFRICAN, Kabenda, mbala

It suffices to say that the yam is not a plant of Australia, but of Central Africa and the West Indies. It has been imported into Australia, by the white colonists.

Cat. AUSTRAL., bededil
AFRICAN, Mimbona, budi

It is necessary that we must refer Mr Hyde Clarke to Wallace's excellent work on the geographical distribution of animals, where he will learn, that Australia never was inhabited by the Felidae, not even in former geological epochs.

Mosquito. AUSTRAL., Yarra, go gook
AFRICAN, Mbamba, ngu-ngu

The African word is a reduplication of ngu, the Australian word closes with a consonant.

Lizard. AUSTRAL., Yarra, tourroop
AFRICAN, tabarrada (according H.C.)

I carefully perused Koelle, but could not find the form quoted by Mr Hyde Clarke. In Class XI. however, Kiriman dialect, we find ntá-baráda, which, as the double accent shows, is a composite, consisting of two roots, and undoubtedly identical with the Nyamban, Class XI., kí-waratáta. Any further commentary is unnecessary.

Little. AUSTRAL., Yarra, wy-krook
AFRICAN, wae-tola accord. H.C.
o-kiere (Bumbete)

The form waetola is not to be met with in Koelle, but Class X., Kasands dialect, has watola and Lubalo watolo and Songo watolu.

Wa is prefix adjectivi, as can be seen under "Great"; wa-kolu in Songo dialect, wa-kolu in Lubalo, and wongulu in Nbamba. There is evidently a greater phonetic resemblance between wykrook and wakolu, than between wykrook and watolu.

As regards the word okiere, we might just as well compare it with Hottentot khari and German klein.

White.	AUSTRAL., Yarra,	tamborreen
	AFRICAN,	[a-pfurag] according to H.C.

Koelle gives under Bumbete a-pfura; a or wa being prefix adjectivi; compare for instance a-pina, *black*. How can therefore the radix pfura be compared with tamborreen?

Black.	AUSTRAL., Yarra,	woo-garring
	AFRICAN,	woo-ripa according H.C.

The form quoted by Hyde Clarke is nowhere to be met with in Koelle; but in Class XI. of the Meto dialect, we find wuripa, wu being prefix and ripa the root.

Young.	AUSTRAL., Yarra,	boop
	AFRICAN, Kanyika,	biop

In Kanyika bi is prefix, leaving op as root; a more primitive form is opa.

Warm.	AUSTRAL., Yarra,	loombadin
	AFRICAN,	[adomi]

The African word is not quite distinctly written in the manuscript copy of Hyde Clarke. If we however should be correct, the word adomi is not to be met with in Koelle's Polyglot. Instead of *warm* Koelle has *hot*, but even under the heading of the latter word in Class X. and XI. there is no word to be met with, which allows a comparison with the Australian word.

Go.	AUSTRAL., Yarra,	yani
	AFRICAN, Lubalo,	yami

The Lubalo form however is an obliterated form of a more primitive one, as can be seen from the Songo giyam. Therefore no comparison can be admitted.

Come.	AUSTRAL., Yarra (?)	wandeat
	AFRICAN	uta

No further commentary is required!

Cough.	AUSTRAL.,	kooningoon
	AFRICAN, Orangu,	ekona

Here Mr Hyde Clarke, to support his theory, passes to Class IX.

Die. AUSTRAL., wykit
AFRICAN, Meto, ukoa

In ukoa u is prefix and koa radix; therefore koa and wykit cannot be compared.

War. AUSTRAL., ngatong
AFRICAN, ngondo, koto

Hyde Clarke has taken the African word ngondo from the Muntu dialect and koto from the Kiriman, to make ends meet. In the word ngondo however n appears to be a prefix, leaving gondo as radix; this root agrees with the Maravi khondo, the Meto koto, and Matatan kodo.

Sun. AUSTRAL., Yarra, ngumi
AFRICAN, Pangela, ekombi
Lubalo, nkima (*moon*)

In the Pangela word e is prefix, and kombi the radix; and in the Lubalo nkima, n is prefix and kima radix. But kima means *moon*, we need therefore say nothing more.

Moon. AUSTRAL., Yarra, meene-an
AFRICAN, Lubalo, moanga (*sun*)

Mo is prefix in the Lubalo word and anga radix. Besides anga *sun* can not be compared with meenean *moon*; but why not rather compare the Australian word with our *moon*?

Sky. AUSTRAL., Yarra, woorwarra
AFRICAN, Kiriman, wa-moluku

Koelle gives the Matatan word, wa-molugu, wa being prefix and moluku radix. Where is the resemblance?

Day. AUSTRAL., Yarra, karromeen
AFRICAN, Musentandu, muini

Where is the resemblance here?

Night. AUSTRAL., Yarra, barren
AFRICAN, Kabenda, buila

Comparison absurd!

Rain. AUSTRAL., Yarra, al
AFRICAN, Meto, epula

In Meto e is prefix and pula radix. In Herero we have omburo, om prefix and buro radix.!

Dew. AUSTRAL., Yarra, warrong
AFRICAN, Sobo, ewuru

The Sobo is a suffix language and in Koelle belongs to Class V., therefore no comparison to be admitted.

Fall. AUSTRAL., Yarra, baderin
AFRICAN, Kabenda, buidi

Mr Hyde Clarke does not quote correctly; the word buidi appears in the Mimbona dialect and Musentandu (om-buidi and mbuidi); the same in Basunde. In Bantu the initial is büi, while it is in Australian ba; the Australian baderin besides ends in a consonant.

Sit. AUSTRAL., Yarra, ngalimba
AFRICAN, Marimba, kala

As can be seen from the Kiriman, Matatan, etc., the fuller form appears to be kelata or kalata. Still it does not compare with the Australian.

Dream. AUSTRAL., Yarra, yi-ook-gen
AFRICAN, gona

I must remind Mr Hyde Clarke that *he* thinks it of great importance, that the initials should agree.

Give. AUSTRAL., Yarra, woonga
AFRICAN, Meto, wunya

Koelle gives for *I give thee*, u wunyā. So nyā appears to be the pronoun of the second person and leaves wu as root.

Cut. AUSTRAL., Yarra, bundi
AFRICAN, Kasands, batura

Koelle gives the word in African for *to cut a tree*. Still no one would think of comparing bátura with bundi.

Two. AUSTRAL., bollo-wan
AFRICAN, beli, peli

There are other more primitive forms in Bantu, like vari and bini. But still beli and bollowan cannot be compared.

Now let us go over to Mr Hyde Clarke's second list.

	AUSTRAL.		AFRICAN.	
Man.	Echuca,	moanit	Kiriman, Maravi	moana
	Yelton,	maalee	Kiriman,	mu-lo
	Morcovia,	nunna	Nyamban,	nona
	Balmoral,	beng	Marawi,	bo-ana

Koelle gives in Kiriman &c. mo-anna, plur. manna, evidently contracted from ma-aña. Therefore mo and ma being prefixes, leave the root anna which cannot be compared with moanit. In Kiriman according to Koelle we have mu-lo sing. le-ana, plur. alo boana, showing lo and ana as roots. Therefore no comparison can here be admitted.

Head. Gunbower, moorun · Kiriman, mu-ru

In the African word *mu* is prefix and *ru* is radix.

Hair. AUSTRAL., Wickliffe, marah
AFRICAN, Kiriman, murit

The root of the Kiriman word is rit, that settles the matter.

Yarra, yarre Meto, ikarare

Absurd!

Gippsland, leet Mutsaya, lefu

In Mutsaya fu is radix.

Echuca, boka Kisama, mbeta

It is not clear where here the resemblance is!

Ear. Echuca, marrmo Matatan, maro

Ro is the root in Matatan. I feel therefore more inclined to compare, à la Mr Hyde Clarke, aro with English *ear* or Latin auris.

In Yarra wooring *ear* is again compared with nyaru in Marawi. Here our author has again quoted wrongly; as Koelle gives the Marawi word sing. kutu and plur. makutu, and in Meto nyaru, plur. maru. This maru is evidently identical with maru in Matatan; and if this be the case, then also wooring in Yarra must be identical with marrmo in Echuca. But this is not the case.

	AUSTRAL.		AFRICAN.	
Tooth.	Echuca,	derra	Nyamban,	di-no
	Sandford,	tungung		
	Yarra,	leeang	Marawi,	leeno

Here again we have another instance of our author melting the prefix and radix together. The Nyamban root is no, having in sing. the prefix di and in plur. ma, therefore derra cannot be compared with no. For the Yarra leeang our friend finds a match in the Marawi leeno. At first the word is again wrongly quoted, second it is not written leeno but li-no, showing the radix no like the Nyamban. Koelle gives in Marawi tsi-no, plur. ma-no; leaving no as root, which is identical with the root no in Nyamban. If these two roots are identical, then also the Echuca derra and the Yarra leeang should be identical. This is not the case.

Mouth. AUSTRAL., Sandford, mullong
AFRICAN, Meto, malagu

As can be seen from the African dialects of Kiriman, Marawi and Runda, ma is prefix and lagu root. That settles the question!

Morcovia, moun Kabenda, munua

Nua is root. Why not rather compare the Australian moun with German mund?

AUSTRAL., Hamilton, kone Lubalo, li-kano

Here it suits our author's convenience to separate the root from the prefix.

Sun. AUSTRAL., Bulloo, tuni (*sun*)
AFRICAN, Muntu, etana (*day*)
Kabenda, tangu

No commentary is required. In the Yarra dialect of Australia Mr Hyde Clarke compares "ngume" (Yarra) with Pangela in ekombi.

The few remaining words produced by Mr Hyde Clarke are not worth discussing.

Our author goes on to say: "It is very seldom that we can so distinctly lay down languages which are really related, but widely distributed. There is therefore no mistake, that the language of the Melbourne tribes is of common origin with those of Mozambique.

"A curious circumstance will be noticed, that though the words may differ internally, they commonly begin with the same consonants in both continents. This serves to mark them. For in the class of languages to which they belong, the Bantu or Kaffre, the initial syllable is of great import."

Mr Hyde Clarke, I hope, will not complain, that I have not paid due attention to this point; and it is chiefly with regard to this point, that I have pointed out his errors. Besides, we have had often occasion to show how careless he is in his quotations, and that sometimes he has even altered Koelle's orthography, thus producing an apparent resemblance between the Bantu and Australian words greater than really exists.

Mr Hyde Clarke, to strengthen his argument, refers to Dr Bleek, saying that this scholar asserted a relationship between the Bantu and Australian languages.

I have tried in vain to get hold of Dr Bleek's paper he refers to, and I was not a little surprised to hear from Miss L. Lloyd, the now acting Curator, that Dr Bleek's paper is not in the Grey collection.

I can however state, from a personal conversation I once had with the late Dr Bleek, that he never admitted a relationship between the Bantu and Australian languages, but that he *morphologically* classed the languages of Australia with those of West Africa (Bornu, Tibbu, Mandenga, etc.)—languages whose formative elements are suffixes and not prefixes as in Bantu.

As to his remark that Dr Caldwell in his *Comparative Grammar of the Dravidian Languages* finds such a wonderful identity of the Australian first personal pronoun with the Dravidian, I may say, that Dr Caldwell weakens his own arguments, by also pointing

to the Tibetian first personal pronoun and the first personal pronoun in Chinese, languages known to belong to the *isolating class.*

Austral.	Drav.	Tibet.	Chin.
1 Pers. ña	na (nan)	ña	ño
2 „ ñi	ñi		

One word more: The Geology, Anthropology and past history of Australia, which is now fairly known to us from the successful researches of B. Smyth, Wallace, Hale, Gerland and Meyer, teach us, that the Australians form a primitive race of mankind "which has been superseded in other countries by somewhat higher tribes, which in successive waves have spread themselves from their original centres." (Wallace.) Agassiz was the first who noticed the fact, and after him it was confirmed by Darwin and Wallace, "that the different races of man are distributed over the world in the same zoological provinces, as those inhabited by undoubtedly distinct species and genera of mammals." (Darwin.) Now the Australian race is almost as peculiar and isolated as its flora and fauna. Moreover, anthropologists and ethnologists, amongst the foremost of whom we may name Wallace, Haeckel and Huxley —have established the fact beyond doubt, that the Papuans of New Guinea and of Melanesia class nearest in their physical appearance with the South African tribes. The Papuans, who are a decidedly higher race, and who most resemble the Africans, may have formed a second great wave of immigration, spreading perhaps by means of islands now sunk beneath the waters of the Indian Ocean. (Wallace.) The centre from which these migrations took place is now generally assumed to be that submerged continent known by the name of Sclater's Lemuria. (Peschel, Haeckel.)

The idea therefore that Australia has been inhabited in prehistoric times by a white race, is too absurd to require any further remark.

V. *On the terms Force and Energy.* By C. LLOYD MORGAN, Esq., Assoc. R.S.M., F.G.S.

[Read 1879, Nov. 26.]

Abstract.

At the outset the chief generalizations of the "Modern Science of Energy" were pointed out.

Energy is defined as the *power of doing work;* and this may be measured by multiplying the mass moved into the space moved through. Two forms of energy are recognized by physicists, *Actual Energy* and *Potential Energy.* Take the case of a swinging pendulum. At the end of each swing, in the transient moment of rest, all the energy is potential; in the lowest position of the "bob" all the energy is actual. In the one case the pendulum can do work by virtue of its position: in the other case it can do work by virtue of its impetus. In other words, the pendulum has potential energy by virtue of its *possible motion;* it has actual energy by virtue of its *actual motion.*

Transformation of Energy. Energy may result from the motion of masses or the motion of molecules. The motion of masses may under suitable conditions be transformed into the motion of molecules, and one kind of molecular motion may be transformed into other kinds. For example, chemical action in a battery, or heat in a thermopyle, may be transformed into electricity: this electricity may be made to take on the form of an electric spark, giving rise to sound, heat, and light, or it may be made to effect chemical decomposition, or again in the electric engine it may be made to raise a heavy weight, the visible motion of which in its fall will, as it strikes the earth, be converted into audible pulses of the atmosphere and into the invisible motion of heat.

Conservation of Energy. Throughout all its transformations energy remains constant in quantity. It may at one time exist as potential energy, in the stone for example that projected from the hand hesitates as it were for a moment before it falls again to the earth; at another time as actual energy, in the same stone for instance as it is actually falling through space; and once more as molecular energy when the stone comes to rest on the earth's surface and gives rise to the motion of molecules. But it always exists. We are never thrown into a state of intellectual confusion by the sudden disappearance of any quantity, however small, of the store of energy in the universe.

Dissipation of Energy. Transformations of energy take place more rapidly in some directions than in others. The result of this

is that all forms tend to be degraded to one (the lowest) form; and this lowest form is heat uniformly diffused throughout space.

Attention having been drawn to these generalizations, some of the confusions arising out of the ambiguity of the word *potential* were pointed out. The following statements of physicists were also commented on. Taking the case of an arrow about to be discharged from a fully-bent bow, one physicist says that the potential energy is in the bow; another describes the arrow as possessing potential energy; while a third speaks of the energy of the system of bow and arrow. To these may be added a fourth view, advocated in this paper, that the energy is in the force or forces concerned.

Force. There are two very distinct definitions of force.

I. *Force is any cause which tends to urge a material point in a definite direction and with a definite acceleration.* II. *Force is the rate at which an agent does work per unit of length.* In this paper the word force is used in the former sense.

Energy of Motion and Energy of Tension. In place of the terms actual energy and potential energy it has been proposed to use the terms energy of motion and energy of tension. Take the case of a ball fastened to one end of an india-rubber string. When the ball is thrown from the hand it has energy of motion: when, however, it is stopped by the stretched string the energy of motion has been converted into energy of tension in the india-rubber. This energy of tension is reconverted into energy of motion as the ball is brought back to the hand by the elasticity of the string. But what, it may be asked, is gained by the use of these terms? It avoids the ambiguity of the word potential. It avoids the confusion which is apt to arise when actual or possible *motion* is the thing regarded. It avoids such a definition as that of Clerk Maxwell, that potential energy signifies the energy which a system has not in actual possession but only has the power to acquire. It draws attention directly to the *force or forces which are in action*, and it leads us up to the truth that motion and tension are the two forms under which force makes itself known to us.

The Persistence of Force. According to the principle of the Conservation of Energy the total amount of energy in the universe remains unaltered. When analysed this conception comes to this; that the sum of the actual and possible motion of a constant quantity of matter is itself constant. But this actual or possible motion is not itself an existence, but only the sign of an existence. And the existence of which it is a sign is force. That is to say, the amount of motion being constant the amount of force which produces that motion must also be constant. This generalization is summed up in the expression Resistance of Force.

Amount of force and Intensity of force. The distinction between the amount of force and the intensity of force must not be lost sight of. They differ in this; that the intensity of force involves the element *time*, which is not involved in the amount of force. It is the amount not the intensity of force which is persistent. These positions in fact may be maintained: I. *Force is that which produces change of position.* II. *Intensity of force is measured by change of motion.* III. *Total amount of force is measured by total amount of change of position.*

Metaphysical Force. There is a tendency among modern physicists to set aside the conception of *force the cause of motion*, as a bit of mischievous metaphysics. The word force is only retained as a convenient expression for a *rate*. It is not a little strange that of two existences, both of which rest on the same basis *experience*, the one (matter) should be regarded as essentially physical, while the other (force) is looked upon as peculiarly metaphysical.

The two objective existences. We are constantly told that there are two things which have objective existences—Matter and Energy. Of these, one (matter) is simple, the other (energy) is compound. For the conception of energy involves the conception of the motion of matter through space. In both cases there is quantitative conservation. The amount of matter is constant. And the amount of actual or possible motion of that matter is also constant.

It is here maintained, however, that the two things which have objective existence are Matter and Force. Both of these are simple indecomposable existences. In both there is quantitative conservation. The amount of matter is constant. And the amount of force, manifested here as motion there as tension, is also constant.

Conclusion. In this paper the value of the principle of the Conservation of Energy is not called in question. As a practical working formula it is invaluable. Nor is it too much to say that through it many branches of physics have been raised to the level of exact sciences.

What is called in question is the statement, that Matter and Energy are the two ultimate physical existences and the Indestructibility of Matter and the Conservation of Energy are the fundamental laws of physical philosophy. And it is here submitted that the two ultimate physical existences are Matter and Force and that the fundamental laws of physical philosophy are the Indestructibility of Matter and the Persistence of Force. What we call Energy is a manifestation of force either under the form of motion or under that of tension. It is by the interaction of matter and force that the varied phenomena of the universe have been evolved.

VI. *Notes on the Habits of some of the Birds of the Transkei.* By H. W. OAKLEY.

[Read November 26, 1879.]

The remarks I am about to make on the habits of some of the Birds of the Transkei have been gathered chiefly in the neighbourhood of Ibeka.

Foremost on my list stands the Common Vulture (*Gyps fulvus*), the Aasvogel of Dutch colonists.

It has always been a source of some controversy as to which organ this bird is indebted for the discovery of its food, whether to the sense of smell or sight, or both combined.

From my observations I have no hesitation in saying that I believe the organ of sight is the one alone employed, and my reasons for arriving at this conclusion are these, viz.: Usually within an hour or more of the death of some animal, such as a horse or an ox, the carcase is attacked by crows, often in considerable numbers, who fight and fly up and down in a manner that is calculated to attract the attention of such a sharp-sighted and hungry creature as a vulture, from long distances. Be this as it may, soon after the crows make an attack, and rarely if ever before, a careful observer may see a bird apparently little larger than a speck appearing over some hill or mountain in the far distance, and as this speck increases in size another and another may be seen following.

This bird as it gradually and unerringly approaches the carcase is soon made out to be a vulture. On arrival it immediately commences its meal, and its company is being continually increased by fresh arrivals.

My opinion is that the vulture is attracted first to its repast by the crows, who are always near at hand, and that one vulture is attracted to the spot by the preceding.

In support of my belief that sight is the only organ employed, I may mention that the olfactory organ in birds is, as far as I am aware, not peculiar for anything extraordinary in its development, while the eye certainly is; in addition to the structure found in the anatomy of the eye of most animals we find that the eye of a bird is provided with a second or rather third eyelid known as the nictitating membrane, that the form of the eye is maintained by a ring of bony plates situated in the sclerotic coat, and that there is

peculiar membrane known as the marsupium, placed at the back f the vitreous humour, and which undoubtedly exercises a conderable influence over the power of focus, and also that the optic obes of the brain are very highly developed. It is said that he vulture never feeds on dead animals until the latter have rrived at a considerable stage of decomposition, and this accounts o some extent for the popular belief that the sense of smell is the rgan that guides it to its meal. But this is very far from being he case, as I have repeatedly seen the vulture feeding on animals hat had not been dead an hour, and Layard speaking of vultures ays:—"On killing a spring-buck or any animal, it is curious to see ow they come trooping in a lengthened string to their anticipated anquet. Though not one may be visible when the shot is fired, n seven or eight minutes hundreds will be gliding to the spot."

The fact is, the vulture is perfectly indifferent as to whether his ood is fresh, or in an advanced stage of decomposition, indeed did he prefer the latter his taste may be considered somewhat refined, if we judge from those bipeds who tell us in cookery books that a pheasant is not fit to be roasted until after having been hung by the tail the body suddenly takes leave of it.

Another popular belief is that the vulture never touches a horse that died of glanders. This is quite erroneous! At Ibeka many of our horses were attacked by glanders, and when dead they were invariably eaten both by crows and vultures; I have seen at least twenty instances. It may be worth mentioning that according to my observations during the late campaigns in South Africa, I have never seen a single case where the vulture had eaten the body of a Kaffir; dead bodies have been lying for many days around our camps, but I know of no instance where they had been consumed by this bird. In one case a horse and man were lying side by side; the horse was soon eaten, but the man left untouched.

Of owls *Otus capensis* appears to be least known; it is described by Layard as *rare in South Africa*, but as far as I have seen it is one of the commonest in the Transkei. It frequents marshy places where rushes abound, under cover of which it conceals itself; and indeed there are very few marshes in the neighbourhood of Ibeka where on walking through several may not be roused from slumber. On disturbing this bird it flies for a short distance and then settles quietly again, turning towards the intruder on its domain, and eyeing him with a careless sort of stare. It appears however to see very well in broad day-light, and never allows itself to be approached too closely while exposed to view. It is somewhat gregarious in its habits, as it would be an unusual occurrence to find less than three, four, or five together.

On examining the stomach of one of these birds that I shot I found it contained a frog.

A friend saw an owl of this species attacked by some crows and two large birds which he described as eagles; on driving the assailants away, it took refuge under the bank of a stream, was easily caught and then handed over to me. I placed it in my tent on a cross bar attached to the pole, where it remained perfectly quiet during the day and apparently well; but on letting it loose in the evening it flew for about a hundred yards and then suddenly dropped dead.

The Kaffrarian Grosbeak (*Chera Progne*), Kaffir Chief, or long-tailed Finch of Colonists, is very abundant in the Transkei, inhabitating the sides of the streams, vleys or marshy grounds which are plentifully supplied with tall reeds and rushes, among which it breeds. This bird feeds exclusively, I believe, on grass and other small seeds, which fact seems well known to the Kaffirs, who place it in their list of harmless birds. It may not be uninteresting to remark that as far as I could understand the natives they divided birds into two great classes, the harmless and the destructive; the harmless are those that do not molest their crops, while the destructive are those that feed on them. It is said of the male Kaffrarian Grosbeak during the breeding season when he has attained his long tail, which measures from 16 to 18 inches in length, that his flight is so impeded that he is often run down and captured, especially during rainy weather; but although I have repeatedly chased him not only on foot but on horseback I never succeeded in catching one. I have also promised the natives rewards to bring me specimens alive, but I never received any.

This bird breeds about November; and in December and January dozens of young birds accompanied by one or more males and females may be seen flying about or perching on the rushes.

When the male bird flies up the side of a hill, keeping close to the ground, he has a very peculiar look, quite unlike a bird, resembling more a thin black dog than anything I can liken him to.

In the winter the male loses his long tail and black plumage and assumes the sober brown colour of the female.

Usually associated with this bird is the *Vidua axillaris*, a bird whose habits are precisely similar to those of Chera Progne, the plumage also being somewhat alike except in wanting the long black tail.

Another little bird of this genus (*Vidua ardens*) is tolerably abundant about the sides of running streams especially the Quora river near Kreli's late Kraal; I have not seen it except in parties of about a dozen containing usually three or four males the rest being females or young; it feeds on grass seeds, and while watching a party eating, I have suddenly seen the whole, apparently without reason, rise up suddenly in the air and fly off in a straight line until lost

o view; when it happens as it does sometimes that a considerable umber of males are present the flight reminds one of a shower of ockets.

The plumage of the male in the breeding season is black ith a broad crescent of orange on the under side of the neck; the ail is black and considerably lengthened, reaching from seven o eight inches.

Inhabiting the same locality as the preceding is the King oodebec (*Vidua principalis*), a little black and white bird not much arger than a common Roodebec, but in the male during the breedng season having the four middle tail feathers lengthened to eight r nine inches. The habits of this bird are similar to those of *Vidua rdens*, but it is much more confiding and familiar. In the evenings hile our horses were being fed in a line outside our camp this ittle bird would invariably come in considerable numbers and wait a few yards off for any grains of Kaffir corn or oats that might be left. I have often noticed that the male bird is never still for more than a few seconds at a time; first he would settle on the ground, then hover a few yards in the air, then settle on a stone, then hover again, and so on. Like the preceding bird, the King Roodebec is generally seen in parties usually of six or seven, each party being composed of two or three males and the rest females or young.

The beautiful rock pigeon (*Columba guineæ*) is very abundant in the Transkei, but only appearing in flocks about the same time as the locust bird. It visited our camp at Ibeka in large numbers night and morning during the time our horses were feeding, and would wait patiently at a distance of about one hundred yards until they had finished, and then directly the horses were driven away, the whole flock would wing its way to the feeding ground, where it would remain for upwards of an hour or so unless molested; afterwards not one was to be seen near the camp until the time again came round for the horses to be fed.

This pigeon usually builds in the crevices of rocks; yet I have seen several instances of its breeding in the hollow of a tree; in one case I saw the old bird sitting on her eggs, and in another I found the young ones almost ready to fly, both nests were made in a tree known as the Kaffir-boom and which overhung the Quora river near Kreli's Kraal.

The common South-African Pratincole (*Glareola Nordmanni*), or small locust bird of Colonists, makes its appearance in the Transkei in large numbers at the beginning of the year. At first only a few are to be seen hawking about in the air after insects with the same ease and swiftness as swallows, or running along the ground with considerable rapidity like plovers, here and there pausing but for an instant to pick up a young locust or grasshopper; and often if shallow water is near running into it and enjoying a bath.

Shortly after the first arrival makes its appearance the number increases until at last a flight of many thousands appears on the scene throwing a shadow over the ground it passes, and the rustling of wings passing by or over one's head is sometimes almost startling. To give some idea of what a number there must be in a flight, I may mention that on the 24th of January last I fired four shots from a breech-loading gun at a flock passing by me, I killed and picked up fifty birds; and on the next day I saw a number fly across and come against the telegraph wire at Ibeka, I with others picked up thirty of these birds either dead or disabled.

The locust bird is excellent eating, so that these eighty birds killed in two days were not wasted.

It would be interesting to note if the locust bird as well as others in time learn to avoid telegraph wires, as it seems is the case in Europe. I remember a Somersetshire farmer relating to me one day while shooting over some of his ground that when the wire was first stretched across his farm it was a common occurrence to pick up partridges, pheasants and other birds that had killed themselves by flying against it, but now, he said, I do not pick up one bird in a year.

The black duck (*Anas sparsa*) is tolerably abundant in the Buffalo River especially so at Fort Murray, near King William's Town, and more or less so in all the rivers up to the Orange River and probably still farther, but here my experience ends. It appears to prefer broad and deep rivers with steep banks and overhanging vegetation, under which it usually lies hidden during the day; but is also not unfrequently met with in vleys and streams whose sides are plentifully supplied with rushes, flags or bushes. When hidden under a bank, although perfectly concealed by vegetation, on hearing footsteps overhead it invariably leaves its haunt and flies a considerable distance if not stopped by a shot.

In the mornings and evenings it is more difficult to approach, and is usually only killed when the sportsman lies concealed amongst thick vegetation over which it flies to and from its feeding ground. It is most difficult to kill by shooting at the back of the bird, whereas a well-directed shot at the breast if it is flying overhead invariably brings it to the ground.

The black duck is almost solitary in its habits, as it is unusual to see more than one or two in company. In flying this bird utters a peculiar quacking noise, reminding the hearer of the European corn-crake (*Crex pratensis*), and which can be heard a long distance. It begins to breed in September, making its nest under the banks of rivers amidst flags and rushes. Its eggs are of a moderate size and beautifully white and glossy.

VII. *The Tsetse Fly.* By Dr B. F. Bradshaw.

[Read January 28, 1880.]

The Tsetse is about the size of a large house-fly, a dark brown colour, and rough appearance; it possesses a proboscis which is divided into three parts, namely, the perforator and two sheaths. The after part of the body is barred with yellow, the wings overlap, and it bears a considerable resemblance to our common cowdung fly at home, is very tough and bears a good squeeze without being any the worse for it.

It inhabits the forest country, on the north bank of the Zambesi, in great numbers, and is found in three belts along the Zambesi road. Commencing at the first, is a belt along the Zambesi and Chobe rivers, varying in width from 8 to 12 miles, and is more numerous in some localities than in others, according to the amount of game, being fewer where game is scarce and "vice versa" is much more plentiful during the winter months, namely, from April to end of September. Then during the summer, the next belt of fly is about 50 miles from the river, along the wagon road, in a southerly direction, between it and Panta ma Teuka, is about 6 miles wide and 8 miles from the trading station at Panta ma Teuka. Sometimes you may pass in the daytime and see no fly, at other times you will notice many. This part of the country is one of those sandy ridges covered with forest so common in the country. About 6 inspans, or 45 miles from Panta ma Teuka, is the third belt of tsetse; the wagons generally inspan after sunset, and trek for about three hours, then tie up the oxen and let them sleep for a couple of hours, inspan again for four hours, and we consider ourselves past the region of fly, which must be 12 or 13 miles wide; it is also very uncertain here, one time very numerous, at another none to be seen. The game also is generally very scarce here. The country consists of heavy sand and forest, being a portion of the sandy pool plateau. The Bushmen have told me that the fly breeds in the buffalo

droppings, and it seems as if there was some truth in it, becau[se] where the buffalos have been driven away in certain tracts, the [fly] has almost disappeared. It is not found on the north bank [of] either the Zambesi or Chobe rivers, close to the water where the[re] are flats. "Wankies" people, the Mashapatans, have informed [me] that before "Mosilikatze" drove them across the Zambesi, the hilly tract of country between the "Gwai" and Daka rivers had no tsetse, was thickly inhabited by three tribes, namely Mashapatans, Matongas, and Batokas, and that they had plenty of cattle, but since the country became uninhabited and overrun with game, it has become one of the great strongholds of tsetse, extending from the Zambesi river for at least 60 or 70 miles in a southerly direction—one effect produced by the Zulus' love of rapine and slaughter.

It bites throughout the day, except when it rains, and during part of the night if warm; in fact I consider it dangerous to travel at night with cattle or horses, until it begins to grow cold towards the middle of the night, as I have been bitten often until past 11 P.M. It is very cunning, always darting, if watched, behind one's back, and if much persecuted with a fly-duster, darts to the grass or bushes, but soon returns to the attack. It will follow, for miles, fresh meat, or natives, but soon returns within its bounds. Tsetse will not stay long in a camp, after fires are lighted, although numerous all round. The Kaffirs have said to me, when much troubled by the fly in camp, Make a fire and they will go away. I found the experiment to succeed. Its buzz is peculiar and not easily forgotten.

The bite causes a similar sensation to a fine needle driven quickly into the skin, causing pain for about a second. As soon as the puncture is made the fly begins to fill itself rapidly, and if it does not succeed in taking sufficient blood it presses its proboscis a little deeper, producing the same pricking sensation as at first. It generally takes from two to three drops of blood, and when full seems to move its proboscis up and down once or twice in the wound; I have never been able to see it inject anything at that moment; then suddenly withdrawing it, it flies down to the grass and sits there distended with blood. Sometimes the tsetse will settle on the neck or face and cause no pain, the first intimation being a slight buzzing sound heard, and immediately after it is seen flying away, or if the hand is put up to the place quickly, it may perhaps be caught full of blood, but one cannot always tell where the exact spot is, from whence the buzzing sound proceeds. The Kaffirs catch them by slipping the blade of a knife or edge of an assegai on their legs and then, turning it carefully over, crush them beneath it. Occasionally the part bitten may feel irritable and one may be obliged to rub it for a few moments, but I never

noticed any further effect on man. I have heard my Kaffir carriers say, when going into a place where the fly was numerous, "Oh! now we shall get thin; look at all the tsetse!" but I never observed any difference in their appearance, although often months at a time in the fly districts.

All domestic animals perish if bitten, sooner or later, with the exception of the goat; the donkey seems to resist it longest. Dogs are taken into the fly district by the Bushmen when pups, and are allowed to suckle the mother, and at the same time given as much fly to eat as can be captured for them. The mother in this case dies and the pups live and grow up, but are the most miserable looking objects I ever saw belonging to the canine race—emaciated, small, and the hair standing straight up all over them. Goats, like all game, get fat and do not seem to mind it. In fact, the Kaffirs keep large flocks in the fly districts near the "Victoria Falls," on the north bank of the river.

Unless bitten by several tsetse, animals do not shew any symptoms in particular until the rains fall. Then oxen especially get emaciated and weak rapidly, much weaker than they would be if in the same condition from poverty alone. The hair stands, the eyes water and have a dull fishy look, the nose also waters, occasionally the feet swell, also the jaw and sometimes under the belly, and the skin has a wrinkled appearance about the hind quarters. If inspanned they soon knock up and lie down in the yoke, and even if, as seldom happens, an ox recovers, he is never good for anything for at least three years, and then cannot do much work in a hot sun.

On skinning an ox if fly-stuck and on examining the skin, you will perceive one or more dark spots, having a slightly bruised look, on the fleshy side. The body presents a wasted appearance, the muscles are flabby, and all the cellular tissues appear at first to be filled with fat, but on closer inspection it is seen to consist of yellow watery particles; there is very little blood in the body, the flesh generally having a bloodless look.

I have seen a great number of animals die from tsetse, especially oxen and donkeys; I have not the slightest doubt that tsetse was the cause of death. For instance, I have passed through the third belt of fly already mentioned, with an ox wagon three times, and allowed the oxen each time to feed. At that time the fly was known to be not far from the north-east side of the road, and nothing happened to the oxen. About a year after a trader came and took three wagon loads of ivory out of the country to Tati. The oxen he had I knew well; they were perfectly healthy, and he was warned about the fly and told not to let the cattle graze on that side of the road. At that time we did not require to go through at night, but he did not regard the advice given.

About two months afterwards I went out to Tati and found several of his oxen dead, others dying, and several died while I was there. I examined those I saw die, and they all presented the same appearance that has been already mentioned. In the end all died, forty-eight in number, and I went on to the Diamond fields and did not lose a single ox, although I had been a whole day standing at the same Pan, where his were bitten, and we both travelled out in the rainy season, but I kept the oxen to the side of the road that had no fly. Now it could not have been a poisonous plant, or it is probable some of the oxen I had with me would have eaten it, as the country for many miles round had the same features, heavy sand, timber, and coarse grass, and in many other places where the soil and vegetation were exactly the same and no fly had ever been seen by any one, no accident ever happened to cattle, although running for months there. Also all cattle that I have seen die in the Zambesi presenting the appearance before and after death just mentioned, had been in one or other of the fly districts shortly before. A coloured hunter had outspanned in the third belt where the forty-eight oxen were bitten, saw fly there and immediately inspanned and trekked, but some time afterwards, three of his oxen died with all the symptoms of fly-bite. He had seen many animals killed by the fly. I saw ten donkeys die from it, but for a long time was under the impression that fly had no effect on them and mentioned that circumstance to Capt. McLeod who was hunting in the Zambesi in 1875—76. But shortly after he left, the donkeys began to get thin and weak, although doing no work for some time, and died quickly, one after another; they had been a great deal in the fly districts, and presented on being skinned the same appearance as fly-stuck oxen. They had not been in the fly since September 1875, and were all dead by the end of May 1876. All that time they had been running on the same belt with several horses, and nothing was ever the matter with any of the horses; as both animals feed much alike, I think it very improbable that a poisonous plant could have been the cause of death. Donkeys certainly resist the effects of fly longer than any animals I know. I went to hunt in 1877 and leaving the wagon outside the Zambesi belt of fly, started with a friend on foot for the river "Chobe" on Feb. 27th. My friend had two dogs about six months old, and one had taken our spoor and come up with us late in the day, where tsetse were in hundreds. We shot some game on the 28th, and on the 29th sent boys to the wagon with meat, and the dog, which latter I had seen bitten several times by the fly during the day previous. We hunted for some time, the weather was very wet, and returned on the 14th March. The dog was looking very dull about the eyes, and not nearly so lively as usual; he gradually wasted away, and was dead in less than a month. The sister

at escaped being bitten lived in good health until taken by a lion December, 1877. A hunter told me if he suspected his horse had en bitten during the dry season, he used to throw a few buckets water over him, and if bitten, the symptoms would develop emselves in a few days.

In conclusion, I may state that having observed the Tsetse and effects more or less for a period of six years, I am fully con-nced that it causes death to all domestic animals, except the at, by its bite. Many traders have told me they believe one fly sufficient to kill an ox, and natives say that if an animal is tten slightly at one time, it is not a preventative against death bitten at a future period.

Fig. 1.

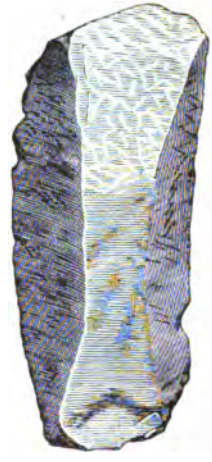

Fig. 2.

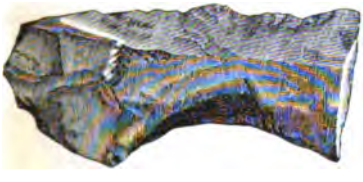

Fig. 3.

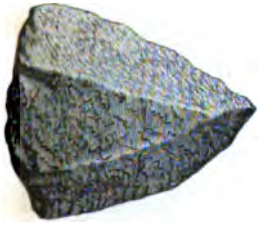

Fig. 4.

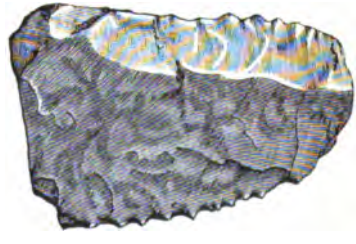

Fig. 5.

Fig. 8.
Fig. 9.
Fig. 11.

Fig. 11. ½.
Fig. 15. ½.
Fig. 18. ½.
Fig. 19. ½.
Fig. 20. ½.
Fig. 21. ½.
Fig. 16. ½.
Fig. 17. ½.
Fig. 22. ½.

Fig. 23.½.

Fig. 26.¼.

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Fig. 29.¼.

Fig. 25.½.

Fig. 30.½.

Fig. 31. ½.

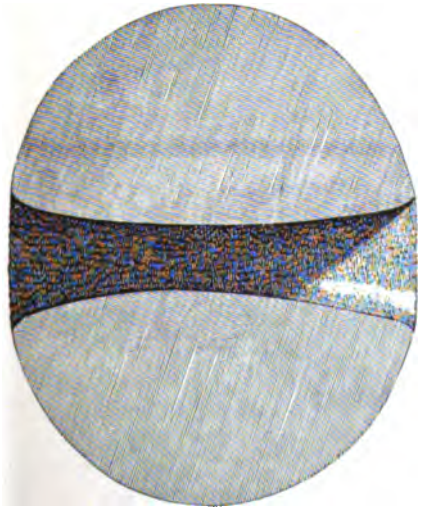

Fig. 32. ½.

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VOL. II. PART II.

[1879—80.]

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1881

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THE TRANSACTIONS

OF THE

South African Philosophical Society.

VIII. *Some Comparative Statistics of the Cape Colony.* By J. X. MERRIMAN, M.L.A.

[Read Feb. 25, 1880.]

THE doctrine, that a careful consideration of the statistics of a country is almost indispensable to good government, is no new one. It was acted upon by most of the nations of antiquity, and the Romans, the foundations of whose empire may be said to have rested on their talent for administration, were especially remarkable for the minute and careful way in which they took due count of the resources of their vast empire. Nor was this census only carried out at stated periods, there is evidence to shew that the daily journals of that age, which answered to our government gazettes, contained very minute particulars concerning the fluctuations of material progress in different parts of the empire, and indeed an old dramatist satirizing the wealthy vulgarian Trimalchio in a well-known passage, gives us a free parody of the exact form in which these daily reports used to appear. In modern times it is needless to point out the importance which is attached to this branch of the science of government, or to enlarge on the almost wearisome minuteness with which most civilized countries and British Colonies think it necessary or desirable to record their resources, to investigate their sanitary condition, and to compare their relative advance or decline in national prosperity from year to year. I fear that it must be added that in this colony we have made but little progress in this direction, although perhaps there

are few of the British possessions where the problems presented
the ordinary course to the government, to say nothing of t
complications which arise from our relations with our neighbou
call for a more accurate knowledge of the distribution and exte
of the resources at our command. It is for this reason, and becau
I believe that no attempt, however crude, to group together su
scattered figures as we possess, and to draw a deduction fro
them, is without a certain value, that I venture to ask yo
consideration to-night to some statistics which bear more i
mediately upon this question of the value of our colonial resource

Population.

At the outset we are met with a considerable difficulty
arriving at what may be considered the primary factor in
calculations of this sort, viz. the population of the colony. For n
only is there a disturbing element introduced by the populatio
beyond our borders, in Griqualand, the Orange Free State, and els
where, who consume our goods and by doing so both add to o
revenue and to the burdens of the administration which has to
provided out of it; but the population of the colony itself, consistin
as it does of a number of people just emerging from barbarism, ca
in no sense be considered as homogeneous, or be treated for th
purpose of comparison with other colonies as if composed entire
of Europeans.

The gross number of inhabitants in the colony at the tim
of the last census in March 1875 was 721,000; viz. 237,000 whi
and 484,000 coloured of different nationalities. The averag
yearly increase will give at the present time a gross populatio
of 821,000, composed of 267,000 white and 554,000 coloured. The
figures do not indeed comprise all the people who come und
colonial law and whose good order the colony has to find means t
secure, but in estimating the colonial resources they are all wh
are subject to direct taxation at the hands of the colony. It
evident that this gross population of 821,000 can scarcely b
reckoned, for the purpose of comparative statistics, as the tru
population of the colony, and the great difficulty is to assign
right value to the coloured in proportion to the European elemen
For the purposes of calculating the relative consumption an
production per head of population it will be convenient to fix as i
the proportion of two to one, viz. two coloured equal to on
European inhabitant, this would give the reduced value of th
population at 544,000 equal to that number of effective consume
and producers.

Taking the gross number of inhabitants as given by the census

e Cape would occupy the following position in comparison with e Australian colonies.

	Taking European only.	Taking the reduced effective population given above the order would be
Victoria	1. Victoria	1. Victoria
Cape	2. New South Wales	2. New South Wales
New South Wales	3. New Zealand	3. Cape
New Zealand	4. Cape and South Australia almost exactly equal.	4. New Zealand
South Australia		5. South Australia

Trade.

Next to the population the consideration of the resources of the untry as shewn by the imports and exports is of the most terest. And here to a certain extent we touch solid ground, and ve at any rate something more than mere conjecture or estimate which to base our conclusions. Taking the imports first we d, that during the past three years the colony has imported ods to the value of

	£	Average for 3 years	per head of mean effective population.
1877.	5,158,348	£	
1878.	6,151,023	6,129,800	£11. 10*s.* 6*d.*
1879.	7,080,229		

or the last year of the period the result per head was £13. 0*s.* 6*d.*

Taking the previous triennial period we find that in the period

	Imports. £	Average.
1874.	5,558,215	£
1875.	5,731,315	5,615,202
1876.	5,556,077	

d, in the middle term of two years which constitutes a transition eriod between the ante diamond field developement and the resent time.

	£	Average for 2 years.
1872.	4,388,728	£
1873.	5,130,065	4,759,396

the period of four years preceding the developement of the amond industry, the figures are:

	£	Average for 4 years.	Value per head of reduced population.
1868.	1,956,154	£	
1869.	1,953,091	2,211,644	£5. 9*s.* 0*d.*
1870.	2,352,043		
1871.	2,585,298		

A comparison between the first and the last of these perio will give a fair measure of the advance of the consuming power the colony, to trace the reasons for which I shall hereaft endeavour. The last period 1868—71 represents the pre-diamo days, when the colonial consumption was measured by a yea average of a little more than two million sterling. The second peri 1872—73 coincides with the first developement of the minin industry at the "dry diggings." The average consumption once doubled, and became of the value of four millions sterlin in the place of two. The third period, 1874—76 marks the fu developement of the great mines at and near Kimberley and al the commencement of our large system of public works. Th average consumption during this period advanced more than million, and finally in the last triennial period the influence of ou loans is to be discerned in the further advance of more than ha a million sterling in our consumption. One melancholy featur must not however be lost sight of in this apparent advance i importation, and that is the truly enormous value of the bread-stuffs taken for consumption in this colony, during the pas three years, which serve to swell very materially the apparen consumption per head.

in 1877	we imported	to the value of	£304,438
1878		„	£543,030
1879		„	£310,971

or an average £386,146 at the rate of nearly 15*s.* per head.

When it is remembered that during a similar period 1876, 1877, 1878 the colony of South Australia, with an European popula-tion almost exactly equal to our own, exported bread-stuffs in addition to its own requirements to the value of

	£	Average.	
1874-5.	1,680,296	£	or per head of population.
1875-6.	1,988,716	1,618,026	£7. 11*s.* 0*d.*
1876-7.	1,184,368		

we see how heavily handicapped we are by this unfortunate demand, and what a vast element of national wealth we are deprived of.

Turning to the exports of the colony during the same period, we are met at the outset with the difficulty, that the colony has apparently made no advance at all. The gross value of exports for 1871 being nearly the same as those for 1879, and the wool export being nearly twenty per cent. less in value than it was in 1867. To a great extent this may of course be accounted

r by the produce of the diamond fields not being included in ur returns, and it is singularly unfortunate that it should be ossible for a commodity which exercises a disturbing influence pon our commerce to the extent of several millions per annum to ake any attempt to register and estimate its value.

During the past three years the value of exports is given at

	£	Average. £	Average per head of reduced population.
1877.	3,542,694		
1878.	3,312,979	3,506,802	£6. 12*s.* 0*d.*
1879.	3,664,735		

nd during

1874.	4,138,838		
1875.	4,088,125	3,875,569	
1876.	3,399,745		
1871.	3,531,609		
1872.	4,757,494	4,332,697	
1873.	3,907,901		
1868.	2,306,698		
1869.	2,225,779	2,367,325	£6. 11*s.* 6*d.*
1870.	2,569,499		

It must be remembered that although diamonds are not ncluded in these returns, all articles produced by the colony tself are given, and the returns per head represent perhaps more ruly than those for imports the actual trade value of the ommunity. It will be noticed that taking the first and the last eriod and comparing the returns per head there has been hardly ny actual increase in our productive power, and as before alluded o, the production of the principal staple, wool, has actually and elatively declined. The question of the decline in the production f wool is so often disputed and slurred over, that the figures since 874 which mark a period of steady declension are annexed. Nothing exceeds the importance of this staple as a solid basis f our colonial prosperity, and it is to be hoped that the reaction hich seems to have set in during 1879 may again carry this rticle to its former place in our exports.

1874.

	weight lbs.	value £ stg.
Fleece washed	10,957,928	683,231
Grease	10,233,535	371,573
Scoured	21,629,018	1,893,573
Total	42,820,481	2,948,377

1875.

	weight lbs.	value £ stg.
Fleece washed	11,306,500	702,354
Grease	8,629,809	319,431
Scoured	20,403,365	1,834,114
Total	40,339,674	2,855,899

1876.

	weight lbs.	value £ stg.
Fleece washed	9,476,955	495,796
Grease	5,271,348	183,171
Scoured	20,113,036	1,599,975
Total	34,861,339	2,278,942

1877.

	weight lbs.	value £ stg.
Fleece washed	7,077,771	358,696
Grease	8,876,837	302,000
Scoured	20,065,963	1,572,059
Total	36,020,571	2,232,755

1878.

	weight lbs.	value £ stg.
Fleece washed	7,299,499	361,843
Grease	6,056,284	180,439
Scoured	18,771,384	1,346,646
Total	32,127,167	1,888,928

1879.

	weight lbs.	value £ stg.
Fleece washed	8,045,573	360,625
Grease	9,808,007	280,630
Scoured	22,233,113	1,513,354
Total	40,086,693	2,154,609

Another item of export, viz. ostrich feathers, has grown int great importance during the past five years, and it is often state that this occupation has interfered with the raising of wool Very possibly there may be some truth in this, but the followin figures will shew that the value of the article, large as it is, by n means compensates for the falling off in the wool exports, and th

fact that the united values of feathers and wool exported for 1879 are less than the value of wool alone for 1874 is deserving the attention of all interested in the progress of the colony.

The value of the export of ostrich feathers is as follows:

	£		£
1874.	205,640	1877.	393,406
1875.	304,933	1878.	591,859
1876.	341,020	1879.	653,756

Before entering on the question of the difference between the colonial exports and imports it may not be uninteresting to compare the values under these heads with those for the several Australian colonies.

During the year 1877, the latest for which complete returns are available, the value of the exports of the following colonies was

	Population.	Value of exports per head. £.	s.	d.	
Victoria	860,787	17	1	3	
N. S. Wales	662,212	19	1	6	
S. Australia	236,864	19	11	0	
New Zealand	417,622	15	3	0	
	Estimated population.				Same during average 3 years.
*Cape Colony	544,000	6	14	6	£6. 12*s.* 0*d.*
The Dominion of Canada		4	8	0	
	During 1875.				
British Guiana		12	1	7	
Mauritius		7	8	7	

The value of imports during the same period was

	per head. £.	s.	d.	
Victoria	19	0	2	
New S. Wales	22	0	1	
S. Australia	19	11	0	
New Zealand	16	14	0	
	For 1875.			average 3 years.
Cape	13	0	6	£11. 0*s.* 6*d.*
Canada	6	19	1	
British Guiana	9	9	10	
Mauritius	6	9	4	

* It has been objected that it is not fair to assume the estimated value of population at the low number of 544,000, and that the coloured bear a higher ratio of value to Europeans than 2 to 1. But in this case the effect would be to raise the numerical value of divisor and so lower the trade value per head of each unit.

It may be worth notice in connection with the above figures that during the gold mining discoveries in Victoria, which are in some measure analogous to our diamond discoveries, the value of imports in 1853 rose to the enormous figure of £81 per head, and the exports during the same year to £56 per head of the population.

Difference between Exports and Imports.

It will be noticed from the figures that have been given that there is a most serious difference between the value of goods returned as exported from, and those imported into the colony. This difference began at the time of the diamond discoveries, and is in a great measure undoubtedly due to the unrecorded value of the diamonds exported; and it is the fashion to dismiss the subject from consideration with the assurance, that the value of diamonds is the element which is wanting to restore the normal balance, which must exist in a country without either manufacturing resources or accumulated wealth, between the imports of goods for consumption and the exports of rough material from which alone these goods can be paid for. Taking the averages for the periods given above we find that

	Average imports. £	Average export. £	Balance.	£
1868-71.	2,211,644	2,658,396	in favour	446,752
1872-73.	4,759,396	4,332,697	against	426,699
1874-76.	5,615,202	3,875,569	„	1,739,633
1877-79.	6,129,800	3,506,802	„	2,623,000

Shewing a steady increase in the trade balances against this colony.

In the past three years the figures are:

	Imports. £	Exports. £	Balance. £
1877.	5,158,348	3,542,694	1,615,654
1878.	6,151,023	3,312,979	2,838,044
1879.	7,080,229	3,664,735	3,415,494

To what is this discrepancy owing? It is not probable that the value of the yield in diamonds is greater than it was in 1872—3 when the mine at Kimberley had been discovered and the diggers were raising diamonds without difficulty of a far larger value per carat than that now obtained for the same article. But whatever the yield of diamonds may be, there can be no doubt that the population at the mining centres has diminished, particularly the consuming European population, and the capital invested is in many cases held in England, to which country returns must be transmitted in money or money's value, reducing

proportionately the amount available for the purchase of imported goods. Yet with a probably diminished and certainly not increased purchasing power the value of importations at colonial ports has steadily increased, and is now a million and a half sterling more than it was during the most prosperous times of diamond mining. Clearly therefore the cause of the large figures by which our trade is measured must be sought elsewhere than in the unknown quantity represented by the export value of the field of diamonds. The population of Griqualand West is estimated on the basis of the census of that territory at 50,000, of whom not more than 15,000 are Europeans, the remainder being for the most part mere labouring savages. This would not give an effective population for purposes of comparison of more than 30,000. Yet we are asked by some recent statistics published at Kimberley to believe that this population absorbs imported goods to the value of two millions and a half, or at a rate per head more than equal to that touched by Victoria in the first rush of the gold discoveries. Looking to all the circumstances of the case and making every allowance for those peculiar to the place, it would not seem possible to allow a consumption of more than one million in value for the population of Griqualand, and we must look elsewhere for an explanation of the large figure by which our import trade is measured.

Setting the diamond fields demand on one side there remain to account for our large purchasing power, as shewn by the absorption of imported goods, the sums derived from foreign capital, borrowed, and expended on our public works and our wars. When it is considered that on the former account upwards of seven millions sterling has been expended, and for war another million, at least, during the last four years, it will be seen at once that the balance of increase in our imports over what we may fairly set down to Diamond Field expenditure, really represents the reflux of capital which we have borrowed for public works, finding its way back to the mother country in exchange for manufactured products, paying toll as it goes in the shape of ten per cent. customs duty. If we compare the period 1874—76, before the effect of our loans had begun to make itself felt, we find that the average balance against the colony was £1,740,000, while for the period 1877—79 the balance was £2,623,000, shewing an average increase of nearly a million sterling a year, which may fairly be held to be an excess over the demand springing from the export of diamonds—and to be attributed to the return of borrowed capital. This is not the place to enlarge on the economic effect of such a sudden inflation, but it is a fact which deserves to be carefully noted and studied by all whose duty leads them to form a true estimate of colonial prosperity.

There remains in conclusion one other cause which accounts for our increased imports, and that is the growing demand among the natives for European manufactures. To a great extent this demand springs from the other two causes above alluded to, viz. the diamond discoveries and the expenditure on public works. It has been estimated by a competent judge, (Mr North) that it costs one half the gross value of the output of diamonds to produce them, and fully one half this cost goes in wages to natives. When we recollect that the yield is generally taken at two millions sterling, we see what an enormous purchasing power is given to the coloured population from this source. The same thing has also taken place on our public works, where at one time nearly ten thousand labourers were employed. It is much to be regretted that there are no figures to shew even approximately the existing demand for manufactured products in such communities as Basutoland and the Transkei. For the former place it has been stated that the importations are at least £300,000 sterling, and for the Transkei I have had several estimates given by trustworthy persons who concur in placing the total demand at over £200,000.

If these figures are correct, and there is no reason to believe them overstrained, we should have an effective demand in these two territories alone of some half million a year, a demand which has certainly sprung up within the last decade, and which promises to be a growing one. This subject is deserving of more ventilation and enquiry, and I feel sure, that if the dry light of statistics was turned on our coloured fellow subjects, we should find that we had in the easily awakened wants of our native population a mine of wealth which only requires to be turned to good account to convince even those who are most disgusted with the extremely troublesome subject known as the native question, that the black man may be worked to pay in this country and to pay handsomely.

IX. *Comets.* By W. H. Finlay, B.A., F.R.A.S.

[Read March 31, 1880.]

Abstract.

As considerable interest had been excited in this subject by the recent appearance of Comet I. 1880, the author first gave a general account of the motions of comets, with particulars of some periodic and remarkable ones. After referring to the comets of 1680 and 1843, the author says, "The recent comet resembled in many points the two I have last mentioned, but I do not think it is a return of either of them.* Part of the tail was first detected, so far as I know at present, at Sea Point on Jan. 31, and a few days afterwards very generally all over the colony: it was also seen by Dr Gould at Cordoba in the Argentine republic. The comet gradually rose higher above the horizon till the head was visible on Feb. 7.

"The first observation of the head that we made at the Observatory was on Feb. 10, and the last on Feb. 17. These are too few and too close together to give a really good determination of the orbit; and it is to be hoped the observers in South America and Australia were more favoured by the weather. I have calculated an orbit from the observations made here on Feb. 11, 13 and 15; and find that the comet passed its perihelion about midnight on Jan. 27, and was then almost as close to the Sun as the comet of 1843. It was then about 700,000 miles from the centre of the Sun, or 300,000 from the Sun's surface. Perhaps a better idea of this distance may be grasped by considering that it was less than a Sun's radius from the Sun's surface, or a little more than the distance of the Moon from the Earth. Of course at this distance it must have passed right through the Sun's outer corona. In consequence of this small perihelion distance its angular velocity in this part of its orbit was enormous. In fact, in the course of two and a half hours at the time of perihelion passage it passed through an arc of 143° in its orbit.

"The tail was longest on Feb. 6: it was then apparently about 50° long, which would correspond to a real length of over 70 millions of miles. At this time the comet was about 62½ millions

* Since this was written, Mr Hind, the Superintendent of the Nautical Almanac, has announced that the elements of the comet of 1843 will satisfy all the observations that he has seen of this comet. It would appear that the observations made use of by me (the only available ones at the time) were not sufficient to give more than a fair approximation to the apparent path of the comet. W. H. F.

of miles from the Earth and 46 millions from the Sun. I find however from my calculations that the comet was nearer to the Earth than this when it was approaching the Sun. At midnight on January 20 it was only 26½ millions of miles from the Earth, and should have been visible in the evening towards the south-west. That it was not seen seems to shew that the tail was not developed till close to or after perihelion passage. It is very much to be regretted that it was not detected, as observations before perihelion passage would have been of the very greatest value. Unfortunately in the Southern hemisphere there is almost a complete lack of amateur astronomers, such as exist all over Europe and America, to whom, considering the few public Observatories in the South and the large amount of more pressing necessities, the work of searching for comets would naturally fall.

"I have not been able to hear of any other observations as yet besides our own, but I have no doubt that Dr Gould at Cordoba will secure some.

"The position of the comet and the direction and amount of its daily motion were telegraphed by Mr Gill to Sir George Airy on Feb. 12, in the hope that some of the more southern Observatories of Europe might secure it; but we have just learnt that unfortunately in the transmission of the message six important figures were dropped, and the result was that no one could tell where to look for the comet.

"The head never shewed any well-marked nucleus, and was always very small: none of the more striking peculiarities of large comets were visible, but this was doubtless owing to the intense heat the comet had undergone."

The author then proceeded to give a description of the phenomena usually observed in connection with a bright comet's tail, with some account of the various theories advanced to explain them.

Tyndall's actinic theory he said had never received much support among astronomers, and though he had not been able to meet with any discussion of the theory, it seemed to him to fail to account for the jets *towards* the Sun which are seen in nearly every bright comet; and he thought that, if the brightness of the tail be due to the absorption of the calorific rays by the head of the comet, the brightness should increase from the edges towards the axis of the tail: but this was completely contradicted by observation. After describing Zöllner's theory, the author concluded with an account of the relations that have been found to exist between meteor-swarms and comets.

X. *On the primeval laws of the Vowels and their bearing on universal Etymology.* By the Rev. F. W. KOLBE.

[Read April 28, 1880.]

It may be laid down as an axiom, that the two first and grand principles in language are *motion* and *space*. The consonants represent, regulate and diversify motion, and the vowels are the signs for the various positions and relations in space. A thorough analysis of Bantu will demonstrate the truth that language is more the offspring of sight than of sound, and that the groundwork, the body of language, was formed by rational observation of the diversified motions in nature. "Tracing the primitive Zulu-Kafir words, remarks the Rev. J. L. Döhne, to their simple roots, we are struck to find that all of them are derived from some kind of motion. In this view the excellent author of the Zulu-Kafir dictionary (a most important work) is certainly right, whatever the value may be of his method of analysis. And one of the foremost workers in philological research, Prof. Max Müller, has arrived at the same result. "To those—says the learned author of Lectures on the Science of Language, vol. ii. p. 70—to those who approach etymological researches with any preconceived opinions, it must be a frequent source of disappointment, when they have traced a word through all its stages back to its first starting point, to find in the end, or rather in the beginning, nothing but roots of the most general powers, meaning to go, to move, to run, to do. But on closer consideration this, instead of being disappointing, should rather increase our admiration for the wonderful powers of language, man being able out of these vague and pale conceptions to produce names expressive of the minutest shades of thought and feeling." These words are very opportune and very true. Indeed, there cannot be the remotest doubt that, with the exception of a small number of mimetic and interjectional sounds, the primary sense in root-words is some motion or other. Thus, in Hererò, to cease, is properly to go far, to run far, out of sight, to disappear; to cut: to go through (with a sharp instrument); to be good—to run over, to abound; to be hard—to tread the ground, to beat a road; to remove, leave—to go out; to send—to cause to go out; to separate—to go between; to stumble—to go down; to shut, bind—to go together, to move together; to grow—to go up; to be aslant—to go out of the straight line;—and all these various relations, far, together, on the surface, in, out, between, aside, up, over, through, down, were originally indicated by vowels.

The vowel sounds had, in the first stage of the development of language, an inherent power to modify the sense of a root. Let us take, for example, the Hererò root-word *pata*. Its radical sense is to move, to go, to run. Now it may be observed that *pata* receives a different meaning when pronounced either *pita* (*peta*) or *puta* (*pota*), though retaining its radical sense; and so it happens that this one root *pata* branches out into a number of words which form a group in the language, very closely allied to each other, viz.,

pata, v. t., to shut, properly to go together, of two parts, or to cause to go together;
pita, v. i., to go from within, to go out;
puta, in *putara*, v. i., to stumble, properly to go downward to the ground.

Corresponding nasalised forms of the above are

panda, in *pandeka*, to bind, properly to go together, to shut;
pinda (Zulu), v. t. (to step out and in), exchange places, return like for like, retaliate;
punda, v. i., to move downward, to descend.

And besides these we meet, by the interchange of consonantal sounds, other forms, such as *vaza*, to reach; *vanda*, to move over the surface, to level; *vinda*, to hide, not less entitled to a place in the *Pata* group. Now in all these words the leading idea is to move, to go, but in each case it is modified by the vowels.

Truth is always simple; so are the laws of the vowels; they may, as far as the outline is concerned, be stated in a few words.

A.

The vowel *a* gives a root the by-meaning

on the surface, level, horizontal,
abroad,
wide, extended, stretched.
far,
straight, in a line,
together, and the reverse, spread, scattered.

Any action, motion or condition, naturally inciting a horizontal gesture, falls within the sphere of *a*.

I

The vowel *i* signifies

in, inside, hidden,
within, and from within,
out,
outside,

at the side,
aside, out of the way,
out of the straight line, aslant,
between.

U.

The vowel *u* has the power of pointing upward to motions and actions in the air which would call forth, as a natural gesture, the lifting up of the arm. U means

up, upward, vertical, perpendicular,
over, hence (as over a river)
through,
overflowing, full,
ahead, before,
erect,
above, and from above,
downward, down,
bowed down, bent, round,
under, below.

The primitive vowels have not, however, in all cases retained their original purity; *a*, in a number of roots, has become *e*; *i* too, often sounds like *e*; and not less frequently we find *u* changed into *o*.

I shall now endeavour to illustrate and exemplify the laws that have been stated, and for that purpose invite attention to a few groups of Hererò root-words. For the sake of brevity and in order to present a clearer view of the several groups, I shall only give the root-word in its simple form.

KAKA, TYIKA, (= KIKA), KUKA.

Kaka (= to go or run on the surface of the earth, to beat a road, make hard, or to go together, to congeal, shrink), to be hard, dry.
Tyika (= to go out of the straight line) to be aslant, to stand obliquely.
Xeka (= to go out of the straight line, out of its proper place) to be or go out of joint, to get loose (as a wagon), to relax (Zulu).
Kuka (= to go up), to rise, swell, increase (in the Zulu word kukumala).
Koka (= to go downward, to bow down), to be bent, crooked (*-koko*, a., crooked).—

Nasalised forms of this group are

KANGA, TYINGA (= KINGA), KUNGA.

Kanga (= to run on the ground, to beat a road, make hard, or to go together, to congeal, shrink), to be hard, dry, or to make hard, dry.

Tyenga (= to go out of the straight line), to upset, as a containing food, throw out (cf. *tyengura*).
Xengaxenga (= to go out of the line), to bend on this and that si to be loose (Zulu).
Kunga (= to run up), to throw up, from the stomach, vomit; run over, as liquids.

TATA, TITA, TUTA.

Tata (= to move or stretch on the surface of the earth), to thr flat on the ground.
Teta (= to go between, divide), to sever, take off the point, crop.
Tiza (= to go out of the straight line), to lean against, to support
Tuta (= to go up, become high), to carry and throw things togeth in a heap, to make a heap.
Tuta and *tota* (= to go through), to hollow or be hollow (cf. *-tutu; -toto*).

Nasalized forms:

TANDA, TINDA, TUNDA.

Tanda (= to move horizontally), to aim at, to fix the eye as in taking aim, hence to intend, devise mischief, threaten (in Zulu, to love).
Tinda (= to go between, to interfere), to resist, refuse (cf. Zulu *tinta*, to intercept, stop).
Tenda (= to go between, divide), to cut.
Tunda (= to go up), to rise, climb, to be erect, high.

PAPA, PIPA, PUPA.

Papa (= to go close together), to be firm, solid, compact.
Pepa (= to go out of the line, out of the straight course), to go aside, start aside, avoid (Kafir).
Pupa (= to move upward), to be light, easy (*-pupu*), to float &c.

Nasalised forms:

PAMBA, PIMBA, PUMBA.

Pamba (= to move close together), to put, as in plaiting, things close together.
Pimba (= to go out and step in, as in changing places, or taking turns; to make room for another or step into the place of another one), to exchange; barter; recompense.
Pumba (= to go up, to move upward, or to cause to go up, to ease, remove a burden, as the superfluous branches of trees, to make light), to prune, to lop; to take off the point, the edge, to blunt; (to rise, accumulate as in) otyi-mbumba, large number of people or things, a heap.

Perhaps these specimens will suffice to give a clear idea of the influence the vowels have had on word-building in Bantu. I might have added a few from Polynesian dialects, but I shall have an opportunity for that in the second part of this paper. For it is certain that the African Bantu and the Polynesian languages form one great family, only with this difference, that the former (especially Hererǒ and Kafir) have preserved best the ancient structure. "No doubt can any longer remain," says Dr BLEEK in his *Comparative Grammar*, p. 143, "as to the fact that the Papuan, Polynesian and Malay languages are related to the Bantu languages, and that thus the Prefix-pronominal Class forms almost one continuous belt of languages on both sides of the equator, from the mouth of the Senegal to the Sandwich Islands."

II.

The bearing of the Laws of the Vowels on the discovery of the unity of Language.

It is well known that in the present state of philological science universal word-comparison is not popular. It is considered mere guess work, and therefore viewed with distrust. And this is not to be wondered at; for, not having any fixed laws to guide them through the labyrinth of roots, some writers have indulged in the wildest speculations and thus brought general etymology into disrepute. Comparative philologists tell us that the only way to prove the relationship between two languages is to shew that both share the same grammatical structure. Not on the casual similarity between words, they argue, but on the agreement in the whole grammatical construction is the affinity between Sanscrit, Gothic, Latin, Greek and the Teutonic forms of speech on the one hand, and the Kafir, Setshuana, Angola, Polynesian on the other, based; and as the former are sex-denoting and the latter prefix-pronominal languages, the two families have nothing in common.

Now this is very true, as far as it goes. To have the thousand-fold varieties of human speech reduced to a few large families, is doubtless a great achievement in modern philology. Still the craving of the thinking mind for something more remains. We are not satisfied with mere divisions and classifications, whilst we are wanting a stand-point from which we may discover their bond of union: we feel the separate circles drawn by Comparative philology to be too narrow, and wish for one large enough to embrace all the families of human language; a natural desire, sometimes even expressed by some of those workers who, for want of laws to guide them further, rigidly adhere to the principle of grammatic identity.

It is obvious that, if the grammatical structure is the only foundation on which comparative philology can operate, any endeavour to discover the unity of language must be considered as futile; for it is plain that, as it regards some families of languages, there is no relationship between their grammatical features discernible, and others are said to be almost entirely wanting in the latter. A broader foundation must be laid and a wider sphere drawn, in which some, if not all, families of languages can unite.

This is desirable; but is it possible?

I venture to answer that there is good reason to believe it is possible. A careful study and analysis of Bantu, and especially a proper knowledge of the powers of the vowels, will furnish us with a new method of Word-comparison, a method unshackled by the different grammatical superstructures; a method which goes in a direct way to the body of language and which therefore may be called the *direct method* of Word-comparison, or also, as it springs from a knowledge of the laws of the vowels, the *Vowel-method*. I shall, of course, in this brief paper not be able to do justice to the subject; many questions in connexion with it I must leave untouched and unanswered, but the outlines of the basis on which the method rests and of the method itself I hope I may succeed in describing in a few sentences.

1. No true root-word stands isolated in language, it is a member of a family, in close relationship to a more or less numerous group; and each group of roots is, whatever individual difference there be, pervaded by one leading idea. We have thus, in universal etymology, to treat a root-word as in affinity and relation to the whole group. We do not compare isolated root-words in the several families of speech, we confront genera with genera, species with species.

2. The classification of root-words into genera and species is effected by the vowels. In a genus we have root-words with the vowels *a*, *i*, *u* and kindred shades of sound, but a species comprises only roots of one primary vowel and its kindred sounds. Thus in Hereró the genus Pa-Ta would comprise roots as the following—*pata, patha, vatha; pita, pitha, vitha, vera; puta, pota, putha, pura*, whereas a species would be confined to *pata, patha*, &c., a second species to *pita, pitha*, &c., and a third to *puta, putha*, &c., though even these species may require subdivision.

3. Now, each genus in Bantu-Polynesian is pervaded by one leading idea, generally to go, to move, to run, the vowel modifying the sense, as has been stated before; producing, as a rule, seemingly opposite by-meanings, as up and down, in and out, &c.; and wherever we find the same phenomenon in other families of speech (however imperfectly the roots may have been preserved) there we discover true relationship and original unity.

The full working out of the principle in question must of course be left to the future and to trained philologists, but in order to make my meaning clear, I shall have to give one or two specimens of general word-comparison as examples, shewing the application of the proposed method.

In Bantu the root *kata* has the meaning to fold, to glue together, to cleave together, cleave to, stick, be attached to, &c. I open Hazlewood's Fijian Dictionary and read: "*kata*, a., close together, touching, as boards on a floor, so as to leave no crevice; *vā-kata*, a., shut, close." Now as the African Bantu and the Polynesian languages form one family, I expect to find it so, and there is no doubt in my mind about the identity of the Bantu and Polynesian root *kata*. It is different, when I turn to other families of speech. The Bantu-Polynesian *kata*, to cleave together, to be close together, reminds me of the Aryan root *kat-* in Lat. *catena*, Germ. *kette*, Dutch *keten* = *chain*, and as *k* and *g* are closely allied, also the root *gat-* (*gad-*, *gath-*, in Germ. *gatte*, Dutch *gade*, *gader*, *gaderen*, Engl. *gather*) occurs to me. Now the question arises, Is the Aryan root *kat-* (*gat-*) identical with the Bantu-Polynesian *kat-*? Without some law to guide me, the answer to this question must be mere guess-work. But here the vowel-method steps in to regulate the inquiry, and I reason thus: *Kata* in Bantu-Polynesian is only a member of a genus of root-words whose leading idea is, to go. *Kata* is a root of the species which means to go together, &c., closely allied to other species, as *kita* (*hita*, *shita*) and *kuta* (*kota*), which respectively mean to go in, to go through, &c. Now if I find in the Aryan family remnants of the genus of which *kata* (or *kat-*, *gat-*) is a member; if I find forms like *hid-*, *shid-*, *shit-* (= *kit-*), with the primary meaning to go in, between, to go out, and *kut-*, *kot-*, to go over, through &c., then I have evidence as strong as can be expected in philology that *kat-*, in Bantu-Polynesian and *cat-*, *gat-*, *gad-* in Aryan are identical.

And it would appear that such forms do indeed exist. Of the number that might be pointed out, I shall only mention a few, as being sufficient for illustration; and I may just remark, in passing, that owing to the peculiar nature of the vowel *i*, roots which must have been originally *kita*, *kila*, *kira* have become *tyita*, *shita*, *sila*, *scira*, &c.

KAT-

means to go together, to shut, to move close together, to cleave to, stick to, &c. Cf. *cat-* in Lat. *catena* = chain; *gat-* in Germ. *gatte*, Dutch *gade* = spouse; *gad-* in A.-Saxon *gador* = together; Icel. *gadda* = to press together; *gath-* in gather.

KIT-

means to go in or between, to go between two parts, to separate,

divide. Cf. *shid* (*kit, kid*) in O. Engl. *shide*; Germ. *scheiden*, Dutch *schieden*; *scir-* in A.-Saxon *scirian, scerian* = to divide, to part among two or more; scidan = to cleave; Icel. skid = shide = a piece split off, splinter.

KUT-

means to go up, over, through, to go through with a sharp instrument, to cut. Cf. Icel. *kut* = to cut with a knife; *kuti* = a small knife; O. Swed. *kotta* = Eng. *cut*.

A comparison of the above forms with corresponding ones in Bantu-Polynesian leads to the following result.

GENUS *Ka-Ta*.

First Species.

KAT- = to go together.

BANTU-POLYNESIAN: *kata* = to fold, press, glue, cleave, join close together (Hereró, Zulu, Fijian); *in-kata*; *on-gata*; *n-gata* = coil, ring or knot of grass, little twigs, &c. for carrying things on the head (Zulu, Hereró, Makonde); *ngata* = bound-up package, bundle (Setshuana).

ARYAN: *kette* (Germ.), *keten* (Dutch); *catena* (Lat.); *gadde* = to press together (Icel.); *gador* (A.-S.), *gather* (E.); *gatte* (Germ.), *gade* (Dutch); *gader, gaderen* (Dutch).

Second Species.

KIT- = to go in, between.

BANTU-POLYNESIAN: *hita* = to go in, between (Hereró); *tyera* = to go between, divide, draw aside, waylay, seduce, pursue (Hereró); *hili* in *faka-hili-hili* = to intercept, turn into another route; *hele* in *faka-ma-hele* = to cut in two; *hele-ua* = divide, cut in two; *helu* = scissors, comb; *helu-helu* = to comb, properly make a path, divide the hair (Tongan); *kilā*, or *gilā* = to know, understand, regard, properly discern, go between (Fijian); *tyiza* = to perceive, discern (Hereró).

ARYAN: *shide* (O. Engl.); *skid* (Icel.) = splinter; scidan (A.-Sax.) = to cleave, split, divide; *scheiden* (Germ. and Dutch) = to go between, separate, part; *scheitel* (Germ.), *schedel* (Dutch) = crown of the head, probably from dividing the hair; *scirian, scerian* (A.-S.) = to go between, to divide, to part among two or more: *shear; share*.

Third Species.

KUT- = to go (up, over) through.

BANTU-POLYNESIAN: *koto* = to crop, to shorten shrubs (Tongan); *konda* = to go over, through; to go over or through a river, to

pass a river; to go through with an edged instrument, to cut through, to saw, to cut off (Hererǒ); *gutu-va* = to cut off (Fijian); *ulu* = to pass through, to go through, as anything thrown or darted (Tongan).

ARYAN: *kuta* = to cut with a knife; *kuti* = a small knife (Icel.); *kotta* = to cut (O. Swed.).

Only one more specimen to show the curious relationships that are brought to light by the application of the vowel-method. One of the most fruitful and wide-spread genera in Bantu-Polynesian and Aryan comprises the aforementioned groups *pata, pita, puta,* nasalised *panda, pinda, punda,* and transposed *tapa, tipa, tupa.* We only refer to the latter form.

Tup- (*tub-, tob-*) in Bantu-Polynesian means

(1) to go up, over, to rise, to be high;
(2) to go (over, i. e.) through;
(3) to go from above or down;

and curiously enough, the same seemingly different or even conflicting meanings we find attached to the Aryan root *tup-* (*tub-, top-*) which appears in such words as *top, tube, stoop,* words which represent the same three-fold meaning as *tup-* in Bantu, viz., to go up, to go through, to go down. And it is just this seeming discrepancy which proves beyond doubt that the Bantu-Polynesian *tup-* (*top-, tub-, tob-*) is identical with the Indo-European *tup-* (*s-toop, tub-, top*).

TUPA

(1) to go up, to rise, to be high.

BANTU-POLYNESIAN: *tupu* = (to rise), grow, increase (New Zeal.); *tubu* = to spring, to grow, to arise from (Tongan); *dub-uza, dub-ula* = to shoot or bud, to shoot into ears, of maize, corn (Zulu); *topa-lala* = to stand upright (Setshuana).

ARYAN: *top* (Sax., Dutch, Fries., Dan.); *topp* (Swed.) *toppr* (Icel.), = summit, the highest part of anything; *stup* = to heap together; *stupa* = heap (Sanscr.).

(2) To go (over), through.

BANTU-POLYNESIAN: *top-ora* = to go through with a pointed instrument, to bore, make holes; *e-tupa* = bone (properly a bored object, something hollow, a tube), (Hererǒ); *i-tuba* = a passage (for going through); *in-tuba* = an opening between rocks, an opening as a window; *isi-tuba* = something like a passage; *tub-ela* = to go through, to creep through (Zulu); *tuba* = a hole or opening, an entrance; *tuba-gi* = to make a hole; *ka-tuba* = an opening, as a window, a door (Tongan); *ka-tuba* = door, window (Fijian).

ARYAN: *tubus, tuba* = a hollow cylinder, a pipe, *tube* (Lat.).

(3) To go from above, down.

BANTU-POLYNESIAN: *topa* = "tomber, crouler, déchoir, rouler, succomber, descendre" (Marquesan); *toba* = to go down with the body, to stoop, bow down (Zulu); *thuva* = to stoop, bow down (Fijian).

ARYAN: *stupa* = to go downward, to be precipitated (Swed.); *stoop* = to move downward, to bow down (E.); *stupian* = stoop (A.-Sax.) *stuypen, stoepen* = to stoop (O. Dutch).

It must be left to future researches to ascertain to what extent the relationship between the several families of speech can be traced. But as to the existence of a close affinity between Bantu and Aryan there can be no doubt. It is true, the Bantu-Polynesian languages are agglutinative and prefix-pronominal, whilst those of the Indo-European family are inflectional and sex-denoting, but this only shews that the former are in an earlier stage of development and much more primitive than the latter. As to their origin, both families are alike; they derived their respective words from one common stock of roots, based on the principle of the powers of the vowels.

XI. *On the Free Rotation of a Rigid Body.* By F. GUTHRIE, LL.B.

[Read May 26, 1880.]

There are four principal cases of free rigid rotation.

(1) When the three principal axes are equal,
(2) When two are equal and less than the third,
(3) When two are equal and greater than the third,
(4) When all are unequal.

In the first three the problem has been completely solved. The fourth however leads us to the solution of elliptic integrals and can only be considered as solved in so far as these integrals are tabulated.

There are two branches to the problem: 1st, the motion of the instantaneous axis among the principal axes, and 2nd, the motions of this axis in space. The first part of the question presents no difficulty, the second only when the axes are all unequal.

Let the principal axes be taken as coordinate axes of x, y and z. From which it follows that the acceleration will be $\omega^2\sqrt{\Sigma p^2b^2c^2}$ about an axis whose direction cosines are

$$a_1 = \frac{pbc}{\sqrt{\Sigma p^2b^2c^2}},$$

whence the acceleration of ω is

$$\omega_1^2\sqrt{\Sigma p^2b^2c^2}\,(aa_1 + bb_1 + cc_1)$$

or
$$-pqrabc\omega^2.$$

The acceleration perpendicular to abc is therefore

$$\omega^2\sqrt{\Sigma P^2a^2},$$

and the angular velocity of the axis of rotation among the principal axes is
$$\dot{\pi} = \omega\sqrt{\Sigma P^2a^2}.$$

The formulae
$$\dot{\omega}_x = p\omega_y\omega_z$$

also give the equations

$$\frac{\omega_x^2 - \omega_{x_1}^2}{p} = \frac{\omega_y^2 - \omega_{y_1}^2}{q} = \frac{\omega_z^2 - \omega_{z_1}^2}{r},$$

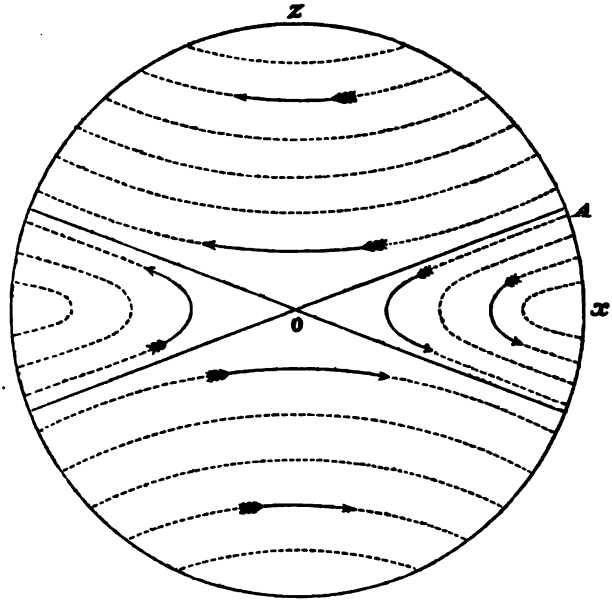
whence can be deduced the relations

$$\frac{P}{P_1}=\frac{Q}{Q_1}=\frac{R}{R_1}=\frac{P-Q}{P_1-Q_1}=\frac{Q-R}{Q_1-R_1}=\frac{R-P}{R_1-P_1}=\frac{\omega_1^2}{\omega^2},$$

and

$$P_1a^2+Q_1b^2-R_1c^2=0.$$

The instantaneous axis of rotation therefore moves in an elliptic cone among the principal axes, the central axis of the cone being always about either the major or minor axis. The following diagram illustrates the nature of the motion, ω being +.



The medial axis Oz is supposed to be perpendicular to the plane of the paper. The dotted lines and arrows represent the motions of the end of the axis of rotation on the surface of a sphere having the centre of motion for its centre, the tangent of the angle Aos being $\sqrt{\frac{r}{p}}$ or $\frac{K_z}{K_x}\sqrt{\frac{K_y^2-K_x^2}{K_z^2-K_y^2}}$.

From this it is apparent that rotation about the medial axis is one of unstable equilibrium; that if it is in the slightest degree disturbed it tends to move further and further away; whereas motion about an axis near either the major or minor axes is comparatively stable; since the axis of instantaneous rotation describes a small elliptic curve about that axis.

The case of rotation about an axis near the minor axis when the minor and medial are nearly equal is interesting. In this case the axis of rotation describes a very elongated elliptic cone, so that its motion becomes nearly vibratory.

Let the principal axes be taken as the axes of x, y and z, and let the radii of gyration about them be K_x K_y and K_z. Let Oz be the major axis and Ox the minor, so that O_x $K_x > K_y > K_z$.

Let $\frac{K_x^2 - K_y^2}{K_x^2}$ $\frac{K_y^2 - K_z^2}{K_y^2}$ and $\frac{K_y^2 - K_z^2}{K_z^2}$ be called p, q, and r respectively.

Let ω be the angular velocity about an axis whose direction cosines are a, b, and c, ω_x, ω_y, and ω_z being the angular velocities about the axes. Let $rb^2 - qc^2$, $pc^2 - ra^2$, $qa^2 - pp^2$ be called P, Q and R, and let particular values of a, b, c, ω, P, Q, and R be called a, b, c, ω, P, Q, and R.

Then calling the angular accelerations $\dot{\omega}$, $\dot{\omega}_x$, $\dot{\omega}_y$, and $\dot{\omega}_z$.

The disturbing moments are easily shewn to be

$$\omega^2 bc\,(\Sigma my^2 - \Sigma mz) \text{ about } Ox$$
$$\text{,,} \qquad \text{,,} \quad Oy$$
$$\text{,,} \qquad \text{,,} \quad Oz$$

whence $\dot{\omega}_x = p\omega_y\omega_z$, $\dot{\omega}_y = q\omega_z\omega_x$, $\dot{\omega}_z = r\omega_x\omega_y$.

The motion of these axes will however be best understood after considering the case of a solid of revolution.

In the case of such a solid $K_x = K_y$ and c and ω remain constant, that is to say the rate of rotation round the instantaneous axis is constant and the distance of that axis from the principal axis is constant likewise; so that the instantaneous axis describes a circular cone round the principal axis.

Also $\theta = -cp\omega$ is uniform, so that the instantaneous axis moves with the uniform angular velocity $cp\omega$ about the principal axis. Since the principal axis is likewise moving with the angular velocity ω about the instantaneous axis, it follows that the instantaneous and principal axes are themselves revolving with a uniform velocity $\dot{v}$ about an axis fixed in space, such that

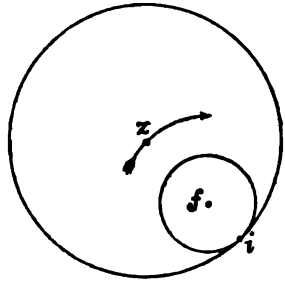
$$\dot{V} = \frac{\omega}{K_x^2}\sqrt{c^2K_x^4 + c'^2K_z^4};$$

calling d and d_1 the cosines of the angles which this fixed axis makes with the instantaneous axis and principal axis, and d' and d_1' the corresponding sines, we get likewise

$$d = \frac{c^2K_x^2 + c'^2K_z^2}{\sqrt{c^2K_x^4 + c'^2K_z^4}} \qquad d' = \frac{\pm cc'(K_x^2 - K_z^2)}{\sqrt{c^2K_x^4 + c'^2K_z^4}}$$

$$d_1 = \frac{cK_x^2}{\sqrt{c^2K_x^4 + c'^2K_z^4}} \qquad d_1' = \frac{c'K_z^2}{\sqrt{c^2K_x^4 + c'^2K^4}}.$$

From these equations it will be easily seen that when $K_z^2 > K_x^2$ as in the case of the earth, the fixed axis lies between the principal axis and the instantaneous axis, and the motion may be completely represented by that of a circular cone having Oz for its axis of angular radius $\cos^{-1}c$, revolving round an *inner* cone having the fixed axis for its axis and the angular radius $\cos^{-1}d$, the instantaneous axis being the line of contact of the two cones.



The radius $\cos^{-1}d$ of the inner cone represents what may be called the wabble of the instantaneous axis, and it will be interesting to investigate the extreme limits of this wabble.

For a given ratio t of $\frac{K_z^2}{K_x^2}$ it can easily be shewn that $\cos^{-1}d$ has its maximum value when $c^2 = \frac{1}{t+1}$, in which case $d = \frac{2\sqrt{t}}{t+1}$. Now the maximum value of t is when the oblate spheroid becomes a flat plate, in which case

$$t = 2.$$
$$d = \cdot 94.$$
$$\cos^{-1}d = 20°.$$
$$c = \frac{1}{\sqrt{3}}.$$
$$\cos^{-1}c = 54°.$$

which is the maximum wabble for an oblate spheroid.

Let us next investigate the wabble of the instantaneous axis in case of the earth supposed homogeneous.

Here $$t = \frac{K_z^2}{K_x^2} = \frac{301}{300} \text{ approximately;}$$

but $$\frac{d'}{d_1'} = c\frac{K_z^2 - K_x^2}{K_x^2} = \frac{c}{300};$$

and if c is nearly equal to unity

$$d' = \frac{d_1'}{300}.$$

That is to say, the wabble would be approximately $\frac{1}{300}$ part of the deviation of the principal and central axes.

If the earth be supposed heterogeneous and the superficial crust half the average density of the whole, then this wabble would be approximately halved, for $\frac{1}{600}$ part of the deviation.

Also for the homogeneous sphere we should get

$$\dot{V} = \tfrac{299}{300}\,\omega,$$

for the heterogeneous sphere

$$\dot{V} = \tfrac{599}{600}\,\omega \text{ nearly.}$$

These values of $\dot{V}$ would obviously affect the rate of precession, which would require to be corrected in a like proportion. That is to say, the precession would be decreased by about $\frac{1}{600}$ part owing to the wabble of the earth's instantaneous axis. As the spheroidal shape of the earth is deduced from the precession of the equinoxes, it follows that the correction which would require to be made would be in the excentricity of the earth's meridional section.

In the case of the oblate spheroid the possible values of t were found to lie between 1 and 2, in the case of the prolate spheroid they lie between 1 and 0, the latter being the limit of t when the spheroid is elongated into the form of a cylinder.

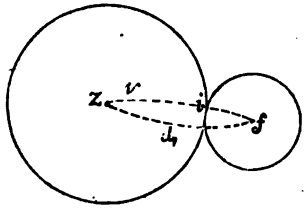
Taking the $$\frac{d'}{d_1'} = c\,(1-t),$$

and remembering that in this case

$$\cos^{-1}c = \cos^{-1}d_1 = \cos^{-1}d,$$

we get $$\frac{\tan V}{\tan d_1} = t,$$

where $$V = \cos^{-1}c,\quad d_1 = \cos^{-1}d.$$



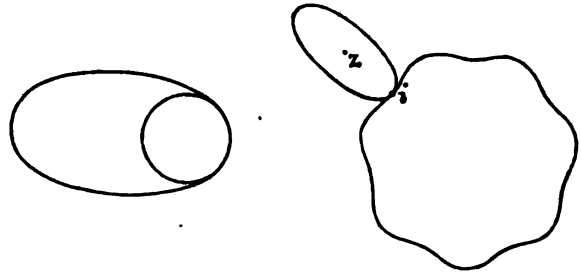
Where t is small, as in the case of an elongated cylinder, it is obvious from this that if the instantaneous axis is not very near the principal axis, the fixed axis is approximately at right angles to the principal axis, but if the instantaneous axis is very near the principal axis, then it is possible that the angle between the principal and the fixed axis may be reduced.

In other words, it is difficult to get an elongated cylinder to turn without a very considerable wabble.

Having thus got some idea of the free rotation of a solid of revolution, we shall be better able to understand the case of the rotation of a body of any form.

In the case of a solid of revolution we saw that the motion of the instantaneous and principal axis could be represented by the rolling at a uniform rate of a circular cone on another circular cone either inside or outside it.

In the case of a body of any shape the motion can be represented by the rotation not of a circular but of an elliptic cone, at a rate not uniform, round another cone which deviates from the circular shape. The shape of the elliptic cone is completely



determined; the rate of rotation relatively to the position of the cone is likewise easily expressed, but the rate of rotation relatively to the time can be only expressed by means of the tables of elliptic integrals.

The equation to the cone about which the elliptic cone rolls cannot be expressed in ordinary algebraical functions, but its intrinsic equation can be expressed, understanding by the intrinsic equation the relation between the angular precession of the generating line and the change of direction of the tangent plane, as $\dot{\pi}$ and ψ.

We have

$$\dot{\pi} = \frac{\omega_1^2}{\omega^2}\sqrt{-\frac{\omega_1^2(Q_1-P_1)(R_1-Q_1)(P_1-R_1)+\omega^2\Sigma pP_1^2}{pqr}};$$

$$\psi = \frac{P_1Q_1R_1}{\pi^2}\,\frac{\omega_1^6}{\omega^2}.$$

from which by eliminating ω we get the relation between $\dot{\pi}$ and ψ.

The resultant rotation about the instantaneous and principal

axes however does not occupy a fixed position, but moves in a very complicated curve of a peculiar form.

As a general result we may state that there is in this case no absolutely fixed axis, that the instantaneous axis always has a wabble, and this wabble is always approximately circular.

In conclusion it may be added that the earth is not really a solid of revolution and has therefore three principal axes, that the position of the two principal equatorial axes has not yet been determined, that owing to the tides they are not absolutely fixed in position, but that they have a tendency to become fixed, and that the positions and motions of these two axes in the earth would probably throw some light on the past, present, and future distribution of land and water on the earth's surface. On the other hand, the radii of gyration about the two principal equatorial axes is so nearly equal that the cone described by the instantaneous axis about the principal axis is approximately circular.

XII. *On the Skeleton of the African Darter or Snake-bird (Plotus Levaillantii, Temm.)* By HERBERT W. OAKLEY.

[Read July 28, 1880.]

The Darter, Snake-bird, or Fresh-water Duiker, named by Temminck *Plotus levaillantii*, belongs to one of the lowest Families of Aves, termed by Ornithologists, the *Pelecanidæ*, viz:— Pelecans, Cormorants, etc:—

It has, as is shewn in the specimen before you, a peculiarly long neck, a sharp-pointed and somewhat compressed beak, the latter being toothed or serrated, in both upper and lower mandibles; and admirably adapted for the capture of its prey, and mode of life.

The tail, which has a remarkably horny appearance, is of a spatulate shape, and the two middle tail-feathers are wavy, or more properly speaking, broadly ribbed or grooved.

The feathers of the neck are short and downy, and those of the body more or less horny in texture, lying close and compact, and singularly suited for its aquatic life.

Its food consists chiefly, and probably entirely, of small fishes, which it obtains by patiently waiting, with the neck bent backwards, as illustrated in the specimen before you, on some overhanging bough or rock, rising above the surface of the water, and from which it enters with such dexterity, silence and ease, as scarcely to cause a sound, or leave a ripple behind to mark the place of its disappearance.

While swimming, the body of the bird is almost entirely submerged, so that scarcely any portion is seen above the surface except the head and neck, which have when seen at a short distance, a remarkably serpent-like appearance, and owing to this it has probably earned the name of Snake-bird.

The anatomy of the bird is singular and interesting, especially its osseous portion, on which the remarks of this paper are chiefly concerned.

In the skull, no inter-orbital septum exists, at least no osseous inter-orbital septum, which is also the case, though possibly to a less extent, in other members of the Natatores or Swimming-birds: but in the vast majority of birds, a well-defined bony inter-orbital septum does exist.

I may mention that in some Reptiles, such as the Amphisbœnoida (Amphisbœnians) and Chamæleonida (Chameleons), there is also wanting an inter-orbital septum, this peculiarity being one of many that is common both to Reptiles and Birds.

At the base of the skull, on the upper edge of the occipital bone, of the African Darter, is a triangular or somewhat perhaps spatulate-shaped bone, which is articulated to the occipital bone by means of cartilage.

It is capable of considerable motion, and as is stated by the late Professor A. H. Garrod, Prosector to the London Zoological Society, affords attachment for the temporal muscle, which is very strong.

The specimen, however, referred to by Prof. Garrod, *Plotus anhinga*, and which was obtained from the Society's Gardens, did not have the process I speak of in a state of ossification, it being simply cartilaginous; he however remarks that his was a young bird and that as age increases the process probably becomes ossified, as appears to be the case with some Cormorants.

The process I have alluded to is unusual in Birds, being found only as far as I know in the Pelecanidæ family.

With regard to the cervical vertebræ, which are twenty in number, including the two last, carrying imperfect ribs, they are peculiar for several reasons.

As pointed out by Prof. Garrod in a specimen of *Plotus anhinga*, the first eight cervical vertebræ, when articulated together in such a way that all the articular surfaces are in their proper relations one to the other, form a continuous curve with a strong concavity forwards.

So great is the curve that when the head of this animal is horizontal the axis of the singularly prolonged eighth vertebra is parallel to that of the skull or at least nearly so. This arrangement is not however peculiar to the Darter, it being found, but in a less marked degree, in the Cormorants, Gannets, etc.

Some of the cervical vertebræ require to be specially noticed om the peculiarity of their structure, the most singular are the ighth and ninth; the eighth is excessively prolonged, and gives ff remarkably long styloid rib-like processes which reach as far as nd lie upon the sides of the hæmal arch of the succeeding ninth ertebra. The eighth vertebra, as before stated, is the one that ives rise to the peculiar kink in the neck of the Darter.

The ninth vertebra, which is much shorter than the eighth, is et more extraordinary in its development: not only has it greatly eveloped styloid processes which extend the whole length of the ertebra; but it is the first developing a hæmal arch, and that uddenly and completely. It also produces a singular ossified ridge on the neural aspect, and which has been denominated 'Donitz's bridge." This bridge is also bony in *Plotus novæ-ollandiæ*; but appears to be simply cartilaginous in *Plotus nhinga*.

The fifteenth vertebra of *Plotus levaillantii* is peculiar for possessing a neural spine, which is not found in either *Plotus nhinga*, or *Plotus novæ-hollandiæ*. The sixteenth vertebra of *Plotus levaillantii*, however, does not develop a neural spine, while in *Plotus anhinga* and *Plotus novæ-hollandiæ*, it is so greatly developed, that Prof. St George Mivart in *Trans. Zoo. Soc. Lond.* ays:—"The sixteenth vertebra is of about the same size as its erial predecessor, but differs from it markedly in the sudden development of a long neural spine." This is most singular and would incline one to suppose that the sixteenth vertebra in this keleton of *Plotus levaillantii* might be misplaced, were it not from the fact that the hypapophyses of both the fifteenth and sixteenth vertebræ agree in size and shape to those described by Prof. Mivart of *Plotus anhinga* and *Plotus novæ-hollandiæ*. The hypapophysis of the sixteenth vertebra is greatly larger than that of the fifteenth, exactly as is stated by Prof. Mivart to be found in the two species he speaks of. It still seems most unaccountable that while the fifteenth vertebra develops a large and well-defined neural spine, the sixteenth possesses none at all, when again suddenly the seventeenth and succeeding vertebræ all possess them.

Closely related to the vertebræ inasmuch so that they might be mistaken for processes, is a remarkable set of ossified tendons in the anatomy of the Darter, either simply articulated by means of cartilage or else ankylosed to the various processes of the vertebræ, especially the lower cervical, the dorsal, and the caudal.

The first to be noticed is in connection with the fourteenth cervical vertebra, attached to the articular processes or zygapophysis of which, and proceeding backwards, are articulated some of the ossified tendons I have alluded to. The fifteenth cervical vertebra has them arising from the neural spine, the zygapophysis,

and the transverse processes proceeding backwards; the seventeenth, from the neural spine both forwards and backwards and from the articular processes backwards. From the eighteenth to the twentieth the ossified tendons are developed from the neural spines and zygapophyses forwards and backwards and from the transverse processes forwards. And from the twenty-first to the twenty-third dorsal these ossified tendons are also articulated or ankylosed to the neural spines, zygapophyses, and transverse processes, proceeding forwards and backwards in the two first named, but in the latter forwards.

There are also ossified tendons directed forwards from the proximal portions of the ilia, and which like those of the transverse processes of the eighteenth to the twenty-third vertebræ are ankylosed, while those of the neural spines and zygapophyses are simply articulated by the intervention of cartilage.

To the processes of the caudal vertebræ are also attached ossified tendons, but which in the skeleton before you have been unfortunately removed.

St George Mivart states in the *Trans. Zoo. Soc. Lond.*, that in the genus Plotus there exists seven or eight pleurapophyses or vertebral ribs, and six hæmapophyses or sternal ribs.

This is certainly not the case in *Plotus levaillantii*, at least in the specimen before you, for although it has seven pleurapophyses, it only has *five hæmapophyses.*

The first pleurapophysis carries comparatively speaking a very small uncinate process, in the three succeeding these processes are greatly developed, in the fifth less so, in the sixth still less so, and the seventh developes none at all.

With regard to the posterior limb of this bird. The fibula is at once ankylosed with the proximal end of the tibia, but almost immediately becomes detached, proceeding downwards in that state for about a quarter of an inch, when it again becomes ankylosed, remaining so until reaching almost the middle of the tibia, when it again becomes detached and remains so until coalescing with the portion of the tarsus that is ankylosed as usual with the tibia. The development of the fibula in this bird is unusual, it being found in the great majority of birds in a very rudimentary condition.

Another point with regard to the leg of this bird is worthy of note. On the inside of the leg, between the distal end of the tibia and the proximal end of the tarso-metatarsus, is a small bone which has not ankylosed either with the tibia or tarso-metatarsus; it is evidently a tarsal bone, and it is unusual to find free tarsal bones in the osteology of birds, they being usually completely ankylosed with either the tibia or tarso-metatarsus, except in the embryonic stage.

In conclusion I may mention that the ease and dexterity of the

Darter in diving so as to leave scarcely a ripple on the water to mark its entrance, has attracted the attention of all who have witnessed it; but no one has, as far as I am aware, attempted to offer an explanation as to how this is accomplished, and which has emboldened me to venture to do so. All who have had experience in diving will be aware, that to dive with ease and grace and to cause the least disturbance to the water requires the body to be as rigid as possible.

It occurs to me that in the Darter the extraordinary ossification of tendons would render this bird admirably fitted to place its body in the most rigid position, which added to the beautifully adapted shape of the beak, head and neck, together with the nature of the feathers, make it in my opinion singularly fitted to perform the feat of diving to the utmost perfection, to which we indeed know it has attained.

I might also add that the tail-feathers in Anserine birds as a rule are very short; and that they use their feet instead of their tails as rudders. Now in the Darter the tail-feathers are unusually prolonged and the tendons of the caudal vertebræ are ossified as before stated, which added to the peculiar spatulate form of the tail, justifies a suspicion that the tail is used more as a rudder than the feet. At any rate, both in flying and diving I have seen considerable motion given to this organ.

XIII. *Note upon the occurrence of a new Puccinia upon Mesembryanthemum micranthum Haw.* By P. MacOwan, B.A. (Lond.)

[Read Sept. 29, 1880.]

In the early part of this year, 1880, there was forwarded to me a curious Coniomycete fungus, parasitic upon one of the Mesembryaceæ commonly burned in the Karoo for soap-ash. I regret that no memorandum of the sender's name accompanied it, and that the impressed postal stamp could not be deciphered to furnish a clue. The plant being new to science and requiring description, it is important to discover the locality and the collector. Hence to draw my unknown correspondent's attention, it may be as well to break through the rule discouraging publication of single species, and confine the present note to his *Puccinia* only.

PUCCINIA MESEMBRYANTHEMI, MacOw. nov. sp.—I. *Fungus hymeniiferus.* (*Aecidium.*) Acervulis plerumque caulicolis, sparsis caulem sæpe cingentibus, aurantiacis, subiculo vix incrassato pseudoperidiis confertis, cylindricis, circa ·2 unc. longis, ore tenu lacero: sporis globosis, interdum subangulatis, diametro circa ·00114 unc., dilute flavis, episporio lævi.—II. Fungus stylosporiferus (Uredo) adhuc ignotus.—III. *Fungus teleutosporiferus.* (*Puccinia.*) Pulvinulis caulicolis foliicolisve, sparsis, paucis, primò sub epidermide arescente tectis, tum hiantibus, lanceolatis, ·5—2· lin. longis, fusco-atris, nitidis, dein erumpentibus, amorphis; sporis ellipticis, medio vix constrictis, longè pedicellatis, circa ·0021 unc. longis, ·001 latis; pedicello hyalino, fragili, ·002—·0024 unc. longo, sursùm incrassato, episporio lævi, apicem versus crassiore.

Hab. In caulibus Foliisque vivis *Mesembryanthemi micranthi Haw.*, loco adhuc ignoto. C. B. S.

PUCCINIA MESEMBRYANTHEMI MacOw. n. sp.—(*Aecidium form.*) Clusters scattered, chiefly arising from the stem and often encircling it, less frequent on the leaves, orange-yellow; subiculum scarcely thickened; pseudoperidia close set, cylindric, ·2 in. long or under, mouth thin, lacerate; spores globose, sometimes sub-angular, about ·00114 in. diameter, pale yellow, epispore smooth. (*Uredo form unknown.*)

(*Puccinia form.*) Pulvinuli rising from stem and leaves, scattered, few, at first concealed by the dry epidermis, then opening, lanceolate, from half a line to two lines in length, brownish black, shining, finally erumpent, amorphous; spores on long pedicels, elliptic, scarcely constricted in the middle, about ·0021 in. long, ·001 in. broad; pedicels fragile, hyaline, ·002—·0024 in. long, thickened upwards; epispore smooth, thicker towards the apex.

Hab. On living stems and leaves of *Mesembryanthemum micranthum Haw.* Exact locality unknown. Cape Colony. This appears to be the first Coniomycete parasite detected upon a Mesembryacea. Its Uredo or stylosporiferous form should be searched for, remembering that it may possibly exist upon a different host-plant, not even belonging to the same Order.

XIV. *Some of the problems awaiting scientific research in South Africa.* By JOHN G. GAMBLE M.A., M. Inst. C. E.

Sir Bartle Frere has implied, if he has not actually said, that the South African Philosophical Society has hitherto hardly justified itself by its works. Perhaps it may be of some small use if an endeavour is made to point out a few of the subjects in which original observation and research may be employed, with advantage to science in general, and to the material progress of this colony in particular. Next to being a scientific searcher oneself, it may profit somewhat to have been a cause of research in others. I do not profess to speak of natural history, but that branch of science is well represented in this Society. I have only to mention the names of MacOwan, Trimen, and Bolus to show that we have workers in natural history whose labours are known and appreciated throughout the world. I will not allude to the noblest of sciences—astronomy,—though I believe that the field of research in the southern heavens has by no means been exhausted; for we have already received from Mr Gill and Mr Finlay valuable contributions, and we may confidently "ask for more." I will confine myself chiefly to two subjects—Meteorology and Geology.

Meteorology. Professor Dove, the great German meteorologist, said that meteorological problems ought to be much easier of solution in the southern hemisphere, because the interference of land masses is so much less. We have, therefore, an advantage here that we ought to give an account of. Starting with the winds, there have been three great laws, or rather generalizations respecting the "viewless winds," as Shakespeare calls them. i. The Anti-trade, first suggested by the astronomer Halley; ii. The law of Gyration of Professor Dove; iii. The Law of Buijs Ballot.

I will endeavour briefly to describe these. Travellers who go from Cape Town to Europe are aware that soon after leaving Table Bay they are helped forward by the south-east trade, and that this wind blows nearly to the Equator, and sometimes across it. After crossing the Equator, the traveller meets the north-east trade. This same phenomenon is observed in the Pacific Ocean, and more or less in the Indian Ocean, though in the latter case, the land-masses at certain times of the year divert the trade, and it is then called a monsoon. All this air blows to the Equator, how does it get back? Halley suggested that it comes back as an upper current, south-westerly in the Northern Hemisphere, north-westerly in the Southern Hemisphere. This suggestion has been abundantly verified by the observation of clouds, and by the direction of the smoke and ashes of volcanoes. Moreover, Piazzi Smyth, the astronomer, who spent several weeks on the Peak of Teneriffe, found himself frequently in a south-west upper current while the north-east trade was blowing below. It is probably this anti-trade which brings to the western parts of the Colony their winter rains. Any observation of upper currents in South Africa would be of service, not only as verifying this law, but also because the movements of the upper current are all-important for determining the laws of wind in general.

ii. *The Law of Gyration*, or Rotation as it is sometimes called, has been brought into prominence by Professor Dove, though he does not claim the discovery of it. In fact, he quotes from Aristotle, Theophrastus, and Pliny, to show that the law is an old one. This law asserts that in the majority of cases a change of wind takes place in the direction in which the sun is moving, and if the wind does change in the other direction it soon comes back, or as Lord Bacon says:—"Si ventus se mutet conformiter ad motum solis, non revertitur plerumque, aut si hoc facit fit ad breve tempus." This law was originally stated for the northern hemisphere, and meant, for example, that the wind changes from south-east through south to south-west, west, and north-west, more often than the other way. That is to say, the direction from which the wind blows changes with watch-hands in the northern hemisphere. But in the southern hemisphere the law has also been verified; and here the change is from north-west through west, south-west, and south to south-east, and so on, or against watch-hands; but still with the sun. Horsburgh, in his sailing directions, says that the wind round the L'Agulhas bank follows the course of the sun, changing from north-west through south-west to south-east. And the old Dutch captains were ordered by the Indian Company that if the wind shifted from south-east to north-east, they were to take in the mainsail, for a hard gale from north-west might be expected. Further investigation of this law for South Africa is very desirable.

iii. The *Law of Buijs Ballot* may be thus stated:—"Turn our back to the wind, and if you are in the northern hemisphere you will have the lowest barometer to your left hand; if you are in the southern hemisphere, the lowest barometer to your right hand." This law has for some time past been recognised as true in hurricanes; but Professor Buijs Ballot first applied it to wind in general. We may state the law in a somewhat different way as follows:—The wind blows round an area of low pressure in a direction opposite to watch-hands in the northern hemisphere, and with the watch-hands in the southern hemisphere. Further investigation has shown that the wind not only blows round, but also in, upon an area of low pressure. The wind, also, to a certain extent, blows out from and round an area of high pressure; but it blows round an area of high pressure in the opposite direction to that in which it blows round an area of low pressure. Lines of equal barometric pressure form curves (called isobars) round areas of high and low pressure, and, as may be expected on mechanical principles, if the isobars are close together, the wind is strong: if far apart, it is weak. The daily charts published for some time past in France and England, and, still more, the charts of simultaneous observations published in the United States have abundantly verified this law. The Scotch meteorologist Buchan has predicted that just as there is in the northern summer a barometric minimum in Northern Asia, so in the southern summer there will be found to be a barometric minimum in South Africa. Buijs Ballot's Law tells us it should be so; for according to that, if we at the Cape turn our backs on the south-easter, we must have a low barometer on our right. So, again, in winter there should be a barometric maximum in South Africa, for we have the north-wester prevalent, and if we turn our backs to it, the high pressure area must be to our left. We may hope that the time will soon come when maps of simultaneous observations will be published for South Africa like those in England, France, and elsewhere. In the meanwhile we should endeavour to verify the law to the best of our abilities.

Among other meteorological problems, is the fluctuation of the barometer in the daily and annual periods. The difference between the barometric readings at nine a.m. and four p.m. is much greater on the Orange River than at Cape Town, more especially in summer. Thus the table of corrections given for the Observatory are not applicable there.

Another interesting study which I might indicate is the dryness or dampness of winds. There is the Cape Town south-easter, and more markedly the Berg wind at George and elsewhere. These are similar to the celebrated Föhn of Switzerland, which on the southern slopes of the Alps is a moist wind, but being forced

upwards expands, and can no longer hold so much moisture in suspension. The result is a deposit of snow or rain on the mountains, and the air descends into the northern valleys a hot dry wind. An interesting way of showing the prevalence or the relative strength of wind is by drawing what are called "windroses," that is by drawing lines from a fixed point parallel to the direction of the observed winds, and by measuring off lengths on these lines proportionate to the frequency or force of each wind. By aid of the observations taken by the Royal Engineers, I have drawn a morning and afternoon windrose for Graham's Town for each month in the year. Among other features it may be noticed that during the summer months the wind is chiefly from the south-west in the morning and from the south-east in the afternoon.

The dust-storms of the Karroo are curious; several of these spiral whirls of dust may frequently be seen at the same time crossing the heated plains. Dr Atherstone says of them, that there is a downward current in the middle, caused by condensation in a thundercloud, that the hot blast is on the outside after the rebound, so that you go through the hot air twice. In consequence of the power of the sun's rays, the surface of the earth is then very hot, the stratum of air next the surface is hotter than the air above, hence the air is in unstable equilibrium, and hence the vertical movement which on mechanical principle assumes a spiral form. Whether electricity is not rather an effect than a cause, I leave to those more familiar with that science to determine.

The similarity of the fluctuations of temperature and rainfall to the changes of the spots in the sun has been noted by observers in various parts of the world, and for the Cape Observatory by Mr Stone. Unfortunately our records from other stations do not as yet embrace a sufficient number of years to test this. Mr Guthrie has already made some valuable researches on the power of the sun's radiant heat. The utilisation of the radiant heat of the sun is one of the pressing problems of science, and one most interesting for South Africa, where the water-power is small, the wind-power at least as fickle as elsewhere, and the coal as yet undeveloped. Could we obtain a commercially practical engine to utilise the sun's rays as power, we might convert many an arid waste into a smiling garden.

Another investigation I would recommend to those who have the time at their disposal, is the examination of periodical variations in the annual range of temperature. As you all know, there are many curious periodicities that have been observed in Europe and elsewhere. For example, there is a curious warm period which seems to recur, in most years, at the end of autumn or beginning of winter. This phenomenon is called "St Martin's summer" in France, the "Indian summer" in Canada, the "Sum-

er of old men" in Germany. Then, again, there is the cold riod at the beginning of April, called the "Borrowing Days." f this it is said in Scotland that

> "March borrows frae April
> Three days, and they are ill:
> The first of them is wun' an' weet;
> The second it is snaw and sleet;
> The third o' them is a peel-a-bane,
> And freezes the wee burd's neb ta'e stane."

re these or others observable in South Africa?

Some time ago, we had a shock of earthquake at the Cape, and he rain, which had been holding off before, fell plentifully afterards. I have been informed that an old inhabitant of Wynberg redicted the sequence; but is the sequence one of cause and effect? Darwin, in his delightful "Naturalist's Voyage," notices the coinidence of rainfall and earthquakes in Chili. He says that the nhabitants are confident of it. Humboldt also notices it for Peru. He says:—"In the parts of America between the tropics, where ccasionally no rain falls for ten long months, repeated shocks of arthquake are felt. The inhabitants do not mind these shocks, or the shocks do no harm to their low huts of reeds; on the ontrary, they regard them as happy forerunners of rainfall and plenty." (Kosmos, i. 221).

I have mentioned wind-power, and there are many windmills in the Colony, chiefly imported from America, but have we the best form for this country? With regard to the theory of the windmill, little has been done since Smeaton, who described the best form of sail, and stated that a velocity of at least three miles an hour is necessary. This velocity can be generally obtained up-country in the summer months, but during the winter there is a comparative calm. Mr William Froude, whose recent death we all so deeply deplore, revolutionised the previous notions on the subject of resistance in *water;* he had also some interesting ideas on the subject of the flight of birds. I trust he may have left sufficient MS. for these to be given to the Royal Society; they may perhaps throw new light on resistance in *air.*

Geology.—In geology we have a very wide field for research. The peculiarity of this country is that it is a very old one. Sir Roderick Murchison tells us that the greater portion of South Africa has maintained its undisturbed lacustrine and terrestrial character since the remote secondary period, the age of the Dicynodon. Naturalists, from the principle of evolution, tell us the same tale. The bird discussed recently by Mr Oakley showed affinities with early forms. The Proteas so characteristic of South Africa, and almost confined to the Cape and Australia, are found

only as fossils in Europe. Are we satisfied that we understa the origin of diamonds, though Dr Cohen has examined th question closely, and Dr Shaw has given us a valuable contributio on the subject? And our coalfields—do we know their thickne their extent, or their connection with geological periods in oth countries? And there is that riddle of South African geology, th curious band of conglomerate that underlies the Karroo shales, an can be traced along the whole southern border of the Karroo fro the eastern foot of the Bokkeveld Mountains, north of Ceres, acro the Beaufort railway near Matjesfontein; the Midland railwa near Mount Stewart, to the Fish River Mouth, beyond Graham Town. It is quite unmistakable, there is nothing else like it. I contains both angular and rounded blocks of quartz and greenstone It was called a claystone porphyry by Bain, and a trap conglomerat by Wyley. One geologist says it was formed by volcanic action; and Dr Sutherland, of Natal, says it is glacial. Mr E. J. Dunn say that the conglomerates on the northern border are glacial; and Mr G. W. Stow, of the Orange Free State, has written several memoir on the Permian boulder beds of South Africa, in which he maintains that these beds are of glacial origin. He says that where the Permian rock has been removed by denudation, the underlying rocks are found marked with deeply incised glacier grooves. On the other hand, Sir R. Murchison says that not a single antarctic or other erratic block has ever been detected in South Africa. It has been pointed out by Dr Griesbach that in Southern India there are strata similar to those of the Karroo, with similar Dicynodon remains, and also resting on a boulder bed. In connection with this we may remember that in Mesozoic times there was a continent "Lemuria," stretching from South Africa to India. Moreover, Africa, Australia, and India were connected up to the early part of the Jurassic age; and Africa and India up to the end of the Miocene. It would be of vast importance to South Africa to distinguish between the permeable and impervious beds, and to define the areas and depths of each. It is here that the fact of our being an old country is again noticeable. We have no water-bearing chalk; we sadly want that fine underground reservoir, the lower greensand, with the clays that cover it, and make artesian borings successful. We have no oolite nor rocks like the new red sandstone, though our most recent formation of any great importance—the Karroo shales—are of this age. An investigation of the curious phenomenon of "aars" would be very useful. In travelling up-country, we frequently see long, straight, thin lines of vegetation, in an otherwise almost desert plain. These are the aars, and it is near these that the farmers dig for water. They are, I believe, generally caused by dykes of impervious rock which intercept the flow of underground water. I have examined many springs, and I

ve frequently found the overlying strata, just at the spring, ted into a sort of anticlinal axis, apparently showing that there something like a volcanic dyke below. Then there are the ntains in the dry river-beds. It is stated that in the Sunday's ver the permanent fountains run weaker after floods. It has en suggested to me, by Mr Alfred Essex, that the silt brought wn by the flood covers the vents and fissures through which the r must go down to take the place of the water oozing from the rous stratum. Hence the water will be retained in its under-ound reservoir until the sun's heat cracks the silts and allows the r to penetrate below. The quantity of silt brought down by some vers, notably the Fish River, is very remarkable, and yet there re deep pools and zeekoegats, where the hippopotamus used to ve, which are not filled up. Probably small floods do tend to fill hem up, and then big floods scour them out again. The shifting hannels of some of the rivers are worthy of observation. Do any f them obey what is called Bär's law, namely, that owing to the arth's rotation, rivers tend to wear away their right bank and ave deposit on the left? Sir William Thomson says that in a anal of uniform section, along which a wave is travelling, the otation of the earth makes the wave cling to the right bank, and Nordenskjöld has observed with regard to the Siberian rivers hich run towards the north that they have low tracts of land on he western bank and cliffs on the east. Other observers have oticed that the Volga and rivers that run to the south have cliffs hiefly on the west bank.

Ocean currents, too, require observation. A few years ago it was believed that there was a more or less constant eddy in Algoa Bay running in an opposite direction to the L'Agulhas current. But the observations of Mr Shield show that no such eddy exists, and that the current in Algoa Bay depends almost entirely on the wind prevailing at the time.

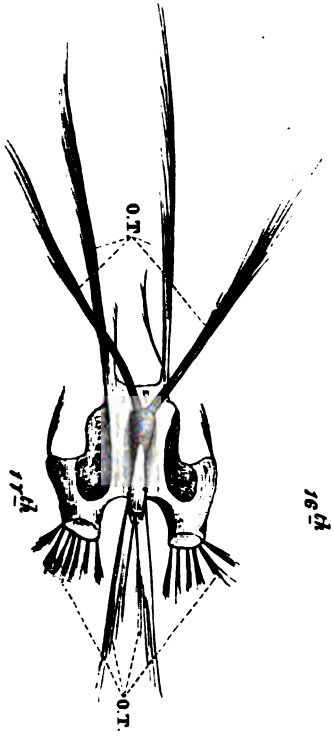
Miscellaneous.—I have already taken up too much time with my remarks, but I will ask your patience while I briefly touch upon a few other questions. The University of the Cape of Good Hope has set as the subject for the Porter medal this year, "Agricultural Chemistry, with special reference to the wants of South Africa." We may hope that by this means some interest may be excited among our students in this very pregnant subject. Take the analysis of manures; I have been told by a practical tobacco grower, that sheep's dung will not do for tobacco; that plant requires cattle dung or vegetable manure. Then there is the analysis of the sweet veld, with its brak water, and the sour veld, with its pure water. The quantity of water that is required for irrigating various crops, is a subject of careful study in Europe; but here there is no quantitative knowledge on the subject, and the

farmer talks about "as much as will go through an inch pipe." I think it will surprise many people to hear that 20,000 gallons of water are required at Uitenhage to wash one bale of wool. That is to say, that the whole present daily supply of Cape Town would only wash fifteen bales. Will not some chemist devise a process for better economising the water? We have many mineral springs, but I do not know that we have any accurate analysis of their waters. I would like to hear the question of "burning the veld" properly discussed. Farmers do it almost everywhere, but I continually come across some thoughtful man who assures me it is a mistake. Near Mossel Bay, for example, some years ago, it is said, grass stood like a corn-field, but that, owing to bush fires, the seed-grass has been all burnt, and there is nothing now but coarse, sour grass.

Then as to the *Arts of Construction*. How is it that the bricks of the colony are generally so bad? Is it the quality of the clay, or the fault of the manufacturer? And the lime—is it not possible to manufacture a hydraulic lime that will compete with Portland cement, that material so precious to all engineers, especially those who have to do with water-works and harbour-works? With regard to timber, is it desirable to plant the slow-growing colonial trees, some of which, like sneezewood, would be almost perfection for sea-works, if we could get the proper sizes; or should we endeavour to acclimatise the jarrah from Australia, the greenheart from America, or the red pine from Northern Europe? Or must we be content to import timber from elsewhere? I have been informed by Major Erskine that quantities of large "mangue" trees can be obtained from the Congo and its tributaries close to the sea. It is said that these are not merely those thickets of interlacing branches and roots that grow in the fetid mud of mangrove swamps in various parts of the world, but tall trees, 60 feet high, and 12 inches in diameter. The teredo will, I believe, not touch the mangue, hence this timber might be as useful as sneezewood or jarrah and more easily attainable. Then as to *constructed works*. Will not Mr Fforde or Mr Jenour give us some information as to the peculiar difficulties of works in South Africa and the special means devised for overcoming those difficulties? With regard to *statistics*, we have had a valuable paper from Mr Merriman; but he will hardly claim to have exhausted the subject. I think the comparative cost of our railways with those of other colonies would show that the Cape has not been badly treated by the engineers that have served her. In New South Wales, I find that the cost of the railway from Sydney to Paramatta, 14 miles long, was £50,000 per mile. The railway from Paramatta to Bathurst cost £25,000 per mile. A railway in Victoria, Australia, 270 miles long, cost £38,000 per mile. The average cost of the

ilway from Capetown to the interior has been less than £8,000
r mile. Other statistics, too, are worthy of study. There
e the statistics of height, weight, length of life, &c., of the
rious races of South Africa. With regard to language we
ve investigations as to the Bushman language, with regard
which European philologists are so anxious. It is most important
at these should be pressed on with all vigour while there
e still a few Bushmen left, and before the language has quite
appeared. And will not someone investigate the changes
d laws by which the fine language of Holland has been de-
aded into the curious patois called Cape Dutch?

In conclusion, I may say that it is no hard thing that is asked.
is not necessary for each of us to be a Huxley or a Tyndall
order to further scientific truth. The patient collector of fossils,
e constant observer of wind or wave, may help to find out
w truths, and may leave his "Footprints in the Sands of Time."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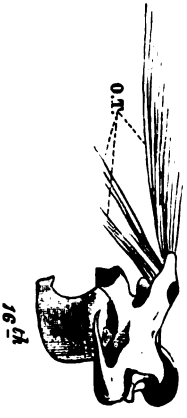
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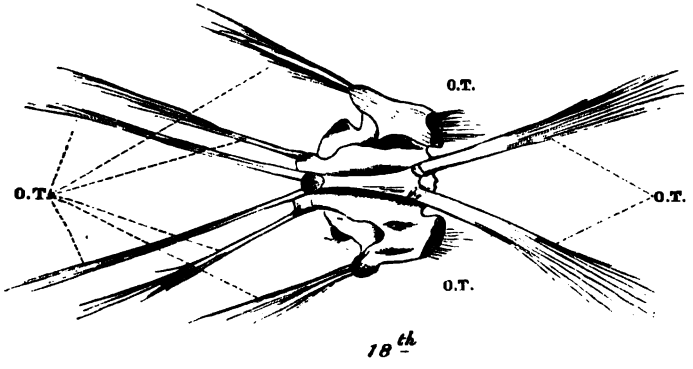

SKULL AND SOME OF THE CERVICAL VERTEBRÆ OF PLOTUS LEVAILLANTII (nat. size).

The Vertebræ are numbered according to their relative position in the skeleton. The 8th, 9th, 15th, and 16th are side views; 17th and 18th upper surfaces. The letters O. T. signify ossified tendons.

LIST OF MEMBERS

OF THE

SOUTH AFRICAN PHILOSOPHICAL SOCIETY

ON THE 31ST DECEMBER, 1880.

Ordinary Members.

Abercromby, A., M.D.
Arderne, H.M.
Ayers, F.
Bain, T.
Bindlêy, Rev. F. W., M.A.
Boettger, G.
*Bolus, H., F.L.S., *Treasurer.*
Bond, Rev. S.
Branford, W. C.
*Bright, H. E. R., F.G.S.
Buchanan, E. J.
Burrowes, F. W.
*Dale, Dr L., M.A.
De Smidt, A.
De Smidt, W., Jun.
De Villiers, Sir J. H., Kt., C.J.
De Villiers, I. H.
Dickson, W. W.
Dunn, E. J., F.G.S.
Du Preez, H. P.
Eaton, C. R.
Ebden, Hon. A., M.L.C.
Ebden, Dr H. A.
Ebden, J. W.
Fairbridge, C. A.
*Fforde, J., C.E.
Fisk, Rev. G. H. R., C.M.Z.S.
*Frere, H. E. Sir Bartle, Bt., F.R.S., &c.
Friedrichs, —
*Finlay, W. H., B.A., F.R.A.S., *General Secretary.*
Fuller, T. E., M.L.A.
Fuentes, F. S.
*Gamble, J. G., M.A., M.I.C.E., F.M.S.
*Gill, David, F.R.A.S., *President.*
Glynn, R.
*Guthrie, F., LL.B.
Hahn, Dr D.
Hahn, Dr Theophilus.
Hawthorne, W. T.
Jenour, A. C.
Jerram, S.
Kitching, Dr C. W., M.B.
Kilgour, G., M.I.C.E., F.R.G.S.
Knox, E. B. J., Assoc. I.C.E.
Lewis, C. E.
Lightfoot, Rev. Canon, B.D.
Lippert, W. A.
Littleton, the Hon. W. F., C.M.G.
McGibbon, J.
McLoughlin, P.
McKeurtan, G.
Marquard, L.
Maskew, F.
Matson, R. R.
*Merriman, Hon. J. X., M.L.A.

Those marked * are the present Members of the Council.

Ordinary Members (continued).

Moore, W. E.
Morgan, C. Lloyd.
Noble, J.
Ogilvie, Rev. Canon, M.A.
Palgrave, W. C.
Redelinghuys, J. H.
Risler, Captain T.
Rutherfoord, F. F.
St Leger, F. Y., B.A.
Saunders, J.
Scanlen, T. C., M.L.A.
Southey, Hon. R., C.M.G.
Schunke, H. C.
Shaw, Dr J., F.L.S.
Silberbauer, C. F.
*Sivewright, J., M.A., C.M.G.
Smith, Hon. C. Abercrombie.
Solomon, S., M.L.A.
Stagg, Capt. G. E. O.
Stegmann, Rev. G. W.
Stevens, C. M.
Stewart, Dr J. G.
Tennant, H., M.L.A.
Theal, G. McColl.
Trimen, R., F.L.S., F.Z.S.
Tweed, A.
Tyson, W.
Upington, Hon. T., Q.C., M.L.A.
Wessels, J. C.
Wiener, J.
Wilson, R.
Whitton, J.
Watermeyer, B.
Young, E. W.

Those marked * are the present Members of the Council.

Corresponding Members.

Arnot, D., F.L.S.
Barber, Mrs.
Bowker, Col. J. H., F.Z.S., F.R.G.S.
Buchanan, Hon. J.
Callaway, Rt Rev. Bishop.
Cohen, Emil.
Exton, H., M.D.
Gooch, W. D.
Holub, E., M.D.
Lanyon, Sir Owen, K.C.M.G.
McOwan, P.
Payn, F. P.
Stent, Sydney.
Warren, Col. Charles, R.E., C.M.G.

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THE TRANSACTIONS

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OF THE

SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

VOL. II. PART III.

[1880—81.]

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Cambridge:

PRINTED FOR THE SOCIETY.

1882

COUNCIL OF THE

SOUTH AFRICAN PHILOSOPHICAL SOCIETY

For 1880—81.

DAVID GILL, Esq., F.R.A.S., H.M. Astronomer at the Cape of Good Hope, *President**.
H. BOLUS, Esq., F.L.S., *Treasurer*.
R. TRIMEN, Esq., F.L.S., F.Z.S., M. Ent. Soc. Lond., *General Secretary* (till 1880, Sept.).
W. H. FINLAY, Esq., B.A., F.R.A.S., *General Secretary* (from 1880, Sept. 15).
H. E. R. BRIGHT, Esq., F.G.S.
L. DALE, Esq., M.A., LL.D.
J. FFORDE, Esq.
His Excellency the Right Hon. Sir H. B. E. FRERE, Bart., G.C.B., G.C.S.I., D.C.L., LL.D., F.R.S., &c.
J. G. GAMBLE, Esq., M.A., M. Inst. C. E., F.M.S.
F. GUTHRIE, Esq., LL.B.
Hon. J. X. MERRIMAN, M.L.A.
J. SIVEWRIGHT, Esq., M.A.

. . . . . For 1881—1882.

J. G. GAMBLE, Esq., M.A., M. Inst. C.E., F.M.S., *President*.
Hon. C. ABERCROMBIE SMITH, M.A., *Treasurer*.
W. H. FINLAY, B.A., F.R.A.S., *General Secretary*.
H. BOLUS, Esq., F.L.S.
D. GILL, Esq., LL.D., F.R.A.S., H.M. Astronomer.
F. GUTHRIE, Esq., LL.B.
P. MACOWAN, Esq., B.A.
Hon. J. X. MERRIMAN, M.L.A.
C. LLOYD MORGAN, Esq.
J. SIVEWRIGHT, Esq., M.A., C.M.G.
R. TRIMEN, Esq., F.L.S., F.Z.S., M. Ent. Soc. Lond.

* The Rules of the Society provide that the President's office cannot be held by the same person for more than two years consecutively.

MINUTES OF PROCEEDINGS.

Ordinary Monthly Meeting.

WEDNESDAY, August 25, 1880.

Dr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

The following donations were announced, and the thanks of the Society voted to the donors of the same, viz. :—

(1) His Excellency Sir Bartle Frere, Vice-President:

Report on the Rainfall in the Dekhan and the Climatic Disturbance during 1861—2.
Bombay Health Officers' Report.
The Great Trigonometrical Survey of India, Vol. V., 1879.
Catalogue of Books on Natural Science in the Radcliffe Library at the Oxford University Museum, 1877.
Report on the Navigation of the Godavery, 1863.
Report on the Indian Famine of 1860—61.
Famine in Madras and Orissa, etc.
Famine in Bengal, Pts. I.—V.
Bengal and Orissa Famine, 3 pts., 1867.
Irrigation in Sind, 1866.
East India Irrigation and Canal Company, 1867.
Report on the Census of Oudh, 1869.
Census of the Island of Bombay, 1864.
Industrial Survey of India, Pts. I., II., 1872.
Indian Public Works, 1879.
Report of the Sanitary Commission for Bombay, 1864.
On the Strength of Cement, by J. Grant, C. E., 1875.
Singular Properties of the Ellipsoid, by Rev. G. F. Childe, 1861.
Ray-surfaces of Reflection, by Rev. G. F. Childe, 1857.
The River Tyne, by the late J. Guthrie, 1880. 8vo.

(2) Dr Holub:

Pts. XIV., XVI., XVII. of his *Sieben Jahre in Süd-Afrika.*

(3) R. Trimen:

On a new species of Roller (*Coracias*), 1880.

A memorandum by His Excellency Sir Bartle Frere, on W. H. Price's paper in the *Society of Arts' Journal* on Kurrachee Harbour Works, was read.

The President, Dr Gill, brought forward the subject of the state of surveys in the colony, and pointed out the advantages of a large primary triangulation.

In the discussion which ensued the following gentlemen took part: His Excellency Sir Bartle Frere, Messrs Fforde, Bright, J. G. Gamble, Marquard, J. X. Merriman, De Smidt and Guthrie.

Ordinary Monthly Meeting.

WEDNESDAY, September 29, 1880.

DR SHAW IN THE CHAIR.

The following donations were announced, and the thanks of the Society voted to the donors of the same, viz.:—

(1) Sir Bartle Frere:

Ten photographs of the head waters of the Ganges, with memorandum.

Irrigation map of India.

Map shewing the irrigation works and tanks near Madras, with note.

Journal of the Society of Arts, Vol. XXVII., 1879.

(2) Dr Holub:

Pts. XVIII., XIX., XX., XXI. of his *Sieben Jahre in Süd-Afrika.*

Mineralogy, by Dr A. Pokorny, 1879.

Mr Bolus read Mr M^{c}Owan's paper "On a New Species of Puccinia." In the discussion that ensued the following gentlemen took part: Dr Shaw, Dr Kitching, Rev. Canon Lightfoot, Messrs Bolus and C. Lloyd Morgan.

Ordinary Monthly Meeting.

NOVEMBER 3, 1880 (postponed from Oct. 27).

DR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

The following donations were announced, and the thanks of the Society voted to the donors, viz.:—

Dr Holub:

Sieben Jahre in Süd-Afrika, by Emil Holub.
Der mond betrachtet als Planet, Welt und Trabant.
Haeckel's *Anthropogenie.*

The President then read a memorandum from Sir Bartle Frere "On the future work of the Society," and some notes of his own on the same subject.

A letter was read from Mr G. W. Theal urging the importance of examining old documents among the Cape Archives.

A paper was read by Mr Gamble, "On some of the Problems awaiting research in South Africa."

In the discussion that followed the following named gentlemen took part, viz.: Dr Dale, Messrs Young and Merriman, Dr Shaw, Canon Lightfoot, Mr Finlay, Rev. Fisk, Mr Bolus, Rev. Stegmann, Hon. J. W. Ebden and Dr Gill.

A resolution was proposed by the Hon. J. W. Ebden and seconded by Mr Branford, "That this Meeting request the Council to take into consideration the question of Public Lectures in Science." Carried.

Ordinary Monthly Meeting.

WEDNESDAY, November 24, 1880.

DR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Several donations of books were announced, and the thanks of the Society voted to the donors.

The President gave an account of the proposed operations for determining the longitude of the Cape by telegraphy, and of longitude determinations in general.

Mr Finlay made a few remarks on some of the older determinations of the longitude of the Cape.

Ordinary Monthly Meeting.

WEDNESDAY, January 26, 1881.

DR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Mr Young exhibited a specimen of sandstone rock which was apparently formed of drifted sand.

Mr Gamble read a paper, "On Irrigation in Madras," written by the Under-Secretary to the Madras Government, and forwarded to the Society by Sir Bartle Frere.

Mr Gamble illustrated the subject by means of wall-diagrams, and drew comparisons between the Madras systems of Irrigation and the Irrigation practicable in South Africa.

Mr Fforde mentioned that he had seen dams in Hungary made of wicker-work that had stood considerable pressure.

Mr Merriman remarked on the usefulness that this paper would be to the farmers of the various districts if it could be conveyed to them. He called attention to the fact that railways in India were not constructed so economically as in South Africa. He also drew attention to what he considered the very favourable circumstances for Irrigation work in South Africa.

Mr Young gave a reason why one of the canals in India had proved a failure.

Mr Gill drew attention to the tanks at Aden, which are supposed to have been constructed by an early settlement of Jews.

The Rev. F. Phillips (a visitor) referred to a difficulty which he had met with in Irrigation, viz., a river getting its channel scooped out, so that the water-course was left 10 or 12 feet high.

Mr Gamble then replied to the various points that had been raised.

Ordinary Monthly Meeting.

WEDNESDAY, February 23, 1881.

DR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Mr H. W. Oakley was duly nominated for election as an Ordinary Member.

The thanks of the Society were voted to Dr Holub, the donor f the following, viz., Pts. XXXII., XXXIII. and XXXIV. of his *ieben Jahre in Süd-Afrika.*

Mr Fuentes read a Paper entitled "Notes on the Soils and lanures suitable for the Cultivation of the Vine at the Cape," lustrated by some diagrams prepared by the Vine Diseases' ommission, which were kindly lent by the Colonial Government.

In the discussion that ensued the following gentlemen took art, viz.:—

Dr Gill, Rev. H. Fisk, Horak de Villiers, and Mr Goodliffe (a isitor).

Ordinary Monthly Meeting.

WEDNESDAY, March 30, 1881.

DR DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

Mr H. W. Oakley was duly elected an Ordinary Member.

Several donations of books were announced and the thanks of the Society voted to the donors, viz.:—

Dr Holub, Sir Bartle Frere and the Director of [redacted] College. Roorkee

Mr Gamble exhibited some drawings, illustrating the difference between the maximum and minimum thermometers as observed at the Camp on Table Mountain, and at the Observatory during January and February, 1881. He also compared the rain-fall at the Camp and the Observatory, during January and February, 1881; and found that there was nearly four times as much on the mountain as at the Observatory in that time. Mr Gamble also exhibited a drawing showing the connection between the discharge of the main-spring, Cape Town, and the rain-fall at the Observatory, since 1868. He also mentioned that he had a rain-gauge constructed and placed on the top of the mountain, which would hold a very large amount of rain, and which he hoped to record during the winter.

In the discussion that ensued the following gentlemen took part, viz.:—

Messrs Rutherfoord, Kitching, Guthrie and Bolus.

Mr Fuentes read a paper "On the Vine and its Culture," &c.

In the discussion that ensued the following gentlemen took part, viz.:—

Messrs Gamble, Guthrie, Kitching, J. H. de Villiers, Goodliffe (visitor), and Dr Atherstone (visitor).

ANNUAL GENERAL MEETING.

FRIDAY, July 29, 1881.

Dr DAVID GILL, F.R.A.S., PRESIDENT, IN THE CHAIR.

The Acting Secretary (Mr Herbert W. Oakley) read the General Report of the Society for the year 1880-81; also (on behalf of the Treasurer) the Financial Report for the same period.

Both Reports were unanimously adopted.

In view of the Ballot for Election of the President and Council for the ensuing year, Messrs J. G. Gamble and G. Fisk were appointed Scrutineers.

At the close of the Ballot at 3 P.M., the Scrutineers reported the number of votes given, and the President declared the following members to have been duly elected, viz.:—

As *President*,—J. G. Gamble, Esq., M.A., M.I.C.E.

As *Members of the Council*,—Dr David Gill, Messrs R. Trimen, C. Lloyd Morgan, J. Sivewright, W. H. Finlay, Hon. C. Abercrombie Smith, P. Mc Owan, H. Bolus, J. X. Merriman, and F. Guthrie.

At 3 P.M. there was an unusually large attendance of the friends of Members, introduced by ticket; and the President soon after proceeded to deliver the Annual Address, which treated (1) on the work done by the Society during the past two years, (2) on various important and exceedingly interesting subjects relative to the welfare of South Africa generally. A vote of thanks to the President for his most valuable and interesting address was moved by Lieut.-General Leicester-Smyth, and carried by acclamation.

REPORT ON THE PROCEEDINGS OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY

DURING THE YEAR ENDING JULY 30, 1881.

1. The Council has the pleasure of submitting to the Annual General Meeting the following Report on the Society's operations during the last twelve months.

2. Since the last Annual General Meeting on Friday, July 30, 1880, seven Ordinary Monthly Meetings have been held. The average attendance of Members at the Monthly Meetings has been 12, and that of Visitors 7, making the total average attendance of Members and Visitors 19.

3. At the Monthly Meetings 10 memoirs have been read before the Society, one of which related to Botany, two to Engineering, two to Viticulture and five to Miscellaneous Subjects. The discussions following the readings of these papers have generally been well sustained and interesting. At some of the Meetings there have been exhibitions of Geological, Zoological and Botanical Specimens, Scientific Apparatus and Books.

4. Valuable donations of Books have been made to the Society by Sir Bartle Frere, Dr Holub, Mr Trimen, and the Royal Society of New South Wales.

5. During the year there has been elected one Ordinary Member, and one Corresponding has become an Ordinary Member. Four Ordinary Members have resigned, one has died, and two have left the Colony. The decrease to the Society during the year has therefore been five Ordinary and one Corresponding Members; our numbers at present being 85 Ordinary and 13 Corresponding Members.

6. Volume II., Parts I. and II., of the Society's *Transactions*, has been received from England, and recently issued to Members.

7. The Society is again indebted to the University Council for granting the free use of its Rooms for the Society's Meetings.

8. At a Meeting of the Council held on the 18th February last it was resolved that various Members of the Society should give a Series of Public Lectures during the Winter months, the first to be given on March 23. Five of these Lectures have been delivered by the following gentlemen, viz.: J. Sivewright, Esq., M.A., C.M.G., "On Electricity"; C. Lloyd Morgan, Esq., "On Geology"; F. Guthrie, Esq., LL.B., "The Sun as a Motor Power"; Dr Halm, "On the Water of Cape Town"; and Prof. M°Owan, "On the Life History of Ferns." On account of the small attendance both of Members of the Society and the Public at each of the Lectures, the remainder of the series has been postponed for the further consideration of the Society.

9. The financial condition of the Society is satisfactory, as will more fully appear from the Report of the Treasurer, which will now be read to the Meeting.

By order of the Council,

HERBERT W. OAKLEY,
Acting Secretary.

THE TREASURER IN ACCOUNT WITH THE SOUTH AFRICAN PHILO[redacted]

FOR THE YEAR ENDED 30TH JUNE, 1881.

Dr. 1880. *July* 1.	£.	s.	d.	£.	s.	d.
To Balance { Fixed Deposit	200	0	0			
To Balance { In Standard Bank	90	7	9			
				290	7	9
To Subscriptions				144	0	0
To Surplus Amount from Dinner to Sir B. Frere				8	8	0
To Sale of the Society's *Transactions*				9	7	6
To Sale of Lecture Tickets				3	16	0
To Interest on Fixed Deposit				16	12	0
				£472	11	3

1881. *June* 30. Cr.	£.	s.	d.	£.	s.	d.
By Advertising, Printing, and Stationery				41	2	6
By Reporting				9	4	0
By Lecturer's Fees				15	0	0
By Clerical Assistance to Secretary				24	0	0
By Attendance at Meetings				8	13	6
By Commission on Collections				6	6	0
By Refreshments at Monthly Meetings				7	10	0
By Furniture, Lighting, &c.				22	18	6
By Contingencies—petty expenses				5	0	6
By Balance { Fixed Deposit	200	0	0			
By Balance { In Standard Bank	132	6	3			
By Balance { Cash in hand	0	10	0			
				332	16	3
				£472	11	3

CAPE TOWN, *July* 7, 1881.

C. ABERCROMBIE SMITH, *Hon. Treasurer.*

We, the undersigned members of the South African Philosophical Society, do hereby certify that we have examined the above account, compared the cash payments with the vouchers, and the balance with the Bank Pass Book and Fixed Deposit Receipt, and find the same to be correct.

CAPE TOWN, *July 7th*, 1881.

C. W. KITCHING,
J. HORAK DE VILLIERS, } *Auditors.*

Memorandum.—The increase of the bank balance from £90. 7*s.* 9*d.* at the commencement of the year to £132. 6*s.* 3*d.* at its close does not indicate a corresponding improvement in the financial condition of the Society. It happened that a number of accounts, including that of Messrs Macmillan & Co., £57. 10*s.* 9*d.*, for printing the *Transactions* of the Society, &c., could not be paid until the 4th instant, on which date the balance in the bank was reduced to £54. 19*s.* 3*d.*, or £35. 8*s.* 6*d.* less than the balance on the 1st June, 1880.—C. ABERCROMBIE SMITH, *Hon. Treasurer.*

ANNUAL ADDRESS TO THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY,

DELIVERED ON JULY 29, 1881.

By Dr DAVID GILL, F.R.A.S., PRESIDENT.

I REGRET it should be so soon after my return from a brief visit to England that I find myself face to face with the duty of delivering the annual address of the Society. The short interval since my return and the pressure of many official engagements have compelled me to make this address more imperfect than I would have desired it to be. I propose to-day:—

1st. Briefly to review the work of the Society during the past two years.

2nd. To note what general scientific progress has been made in South Africa during the same period, and,

3rd. To indicate some few points where the teaching of science may be well invoked in connection with the practical needs and requirements of the colony.

The following is a list of the papers read before the Society during the past two years.

ASTRONOMY (1).—"On Comets," by W. H. Finlay, B.A., F.R.A.S.

GEOLOGY (1).—"On the Stone Implements of South Africa," by E. J. Dunn, F.G.S.

ZOOLOGY (5).—"On the Tsetse Fly," by Dr Bradshaw. "On the Habits, &c., of some of the Birds of the Transkei," by H. W. Oakley. "On the Skeleton of the African Darter or Snake-bird" (*Plotus Levaillantii*), by H. W. Oakley. "On the 'Singerjee Cicada'" (*Platypleura Capensis*), by C. Lloyd Morgan. "Locusts and Locust Birds," by Mrs Barber.

BOTANY (1).—"On a New Species of Puccinia," by Professor McOwan.

GEOGRAPHY (1).—"On the Geography of South-West Africa," by H. C. Schunke.

PHILOLOGY (4).—"Contributions to a Comparative Dictionary of the Bantu Languages," by the Rev. C. G. Butner. "On the Languages of the Mozambique and of the South of Africa, in their relation to the languages of South Australia," by Hyde Clarke.

A Critique on Mr Hyde Clarke's Paper," by Dr Hahn. "On he Primeval Laws of the Vowels, and their bearing on Universal Etymology," by Rev. F. W. Colbe.

ENGINEERING (3).—"On the State of Surveys in the Colony," by David Gill, LL.D., &c. "A Storage Reservoir in the Achterveld," by J. G. Gamble, M.A., M.I.C.E. "On a paper on Irrigation in Madras," written by the Under-Secretary to the Madras Government by J. G. Gamble, M.A., M.I.C.E.

VITICULTURE (2).—"Notes on the Soils and Manures suitable for the Cultivation of the Vine at the Cape," by F. S. Fuentes. "On Grape Culture and Manufacture of Wine," by F. S. Fuentes.

PHYSICS (2).—"On the terms Force and Energy" (abstract), by C. Lloyd Morgan. "Free Rigid Rotation," by F. Guthrie.

MISCELLANEOUS (7).—"Some Comparative Statistics relating to South Africa," by Hon. J. X. Merriman, M.L.A. "On the proposed Operations for determining the Longitude of the Cape by Telegraphy," by David Gill, LL.D., &c., Astronomer-Royal. "On Comets," by Mr Finlay. "A Memorandum" by Sir Bartle Frere on W. H. Price's paper in the *Society of Arts' Journal* on "Kurrachee Harbour Works." "Memorandum on the Future Work of the S. A. Phil. Society," by Sir Bartle Frere. "On some of the Problems awaiting Research in South Africa," by J. G. Gamble, M.A., M.I.C.E. "On the Durability of some Colonial Timbers," by J. Sivewright, M.A., C.M.G.

Nor can I omit to notice the valuable donations to the Society, and especially the gifts of Sir Bartle Frere and Dr Emil Holub.

It is pleasant to think that our founder, Sir Bartle Frere, still retains the same devotion to the welfare of the Society which he showed in its commencement, and that neither time nor distance has diminished his interest in its progress, nor his earnest desire to promote its usefulness and prosperity by every means in his power.

It is also very pleasant to think that our intercourse with Dr Holub has been so kindly and so gratefully remembered, and that we may hope to have again the pleasure of seeing him on his way to fresh enterprise, and, still better, to welcome him back again after another term of further discovery and wider work in Central Africa.

Such, briefly summed up, has been the work of the Society during the past two years. Whether it is an amount of work creditable to ourselves or honourable to the colony are questions which it hardly becomes me to answer. But, be the answer what it may, no one can deny that what has been done is better than nothing. It is work that, but for the Society, would probably have remained undone, and which, but for the Society, would almost certainly have remained unpublished, and therefore useless to the world.

The work of original research is slow, and the labourers are few, but there are amongst us those upon whom we may confidently reckon.

In the department of Natural History we have Mr Trimen and Mr Oakley, Colonel Bowker, Mrs Barber, Dr Bradshaw, Prof Lloyd Morgan and others.

In Botany we have Professor McOwan and Mr Bolus, good and tried men.

In Philology we have Dr Theoph. Hahn, of the Grey Library, and many zealous Missionaries working in co-operation with him.

On the problems of local Engineering we can rely upon Mr Gamble; and I would hope we may also have interesting communications from other Engineers throughout the colony, as, for example, the experiences of our Harbour Engineers at Table Bay, Port Elizabeth, and East London, and from others on the peculiar engineering problems to be dealt with in the great railway extension about to be undertaken.

To Professor Guthrie, as of yore, to our new President in the future, to the members of the Observatory staff, and others, we may look for useful communications in pure and applied mathematics. To Mr Merriman we turn for more interesting papers on South African statistics, and probably Mr Abercrombie Smith, out of the vast store of figures over which he officially presides, may be able to extract some both useful and interesting. I need not mention the many workers in Geology, there are so many inducements in South Africa, and such a wide and profitable field for work, that one need not fear that much will not be done. Much of the geological work performed finds its way into Blue-books and other official documents, and I would suggest that some member of the Society should annually make an abstract of noteworthy points in the South African geological work yearly for publication in our *Transactions*.

There is much, for example, in Mr Molyneux's report on the geology of the Karroo and Stormberg, that, in a condensed and digested form, would make a valuable addition to our *Transactions*, where, too, the information would become more accessible to geologists in general than in official blue-books.

To those of my audience who may desire to work in science, to those who are looking for a field for such work, I recommend a perusal of an admirably suggestive paper by Mr Gamble, "On some of the Problems awaiting Scientific Research in South Africa," printed in Part II. of Vol. II. of our *Transactions;* and, in a wider field, the address of Sir Bartle Frere, as delivered by him in 1879 from this chair, and printed in Vol. I. of the Society's *Transactions*, is particularly valuable.

It would appear, then, that we neither lack men nor opportunity for work, and that zeal alone is required to insure the progress of the Society.

I think I have sufficiently shown reasons at least why we should continue to exist, and without criticizing what we have done in the past, may fairly say I hope and believe we shall do more in the time to come.

I would now pass from the immediate work of the Society to the wider subject of general scientific progress in South Africa.

Meteorology.

In matters which come more peculiarly under my own notice, and which are most connected with my daily work, I would allude in the first place to what has been done in South African meteorology.

For a number of years a Meteorological Commission has been in existence in South Africa, and numerous stations have been founded throughout the colony. Aided, in the first place, by an annual grant of £250, expended under the direction of a Meteorological Commission, these stations were provided with the necessary instruments.

For standard stations the instruments are a barometer, wet and dry bulb thermometers, a maximum and minimum thermometer, a rain-gauge, and an anemometer. At minor stations only a rain-gauge. In the year 1876 there were only 13 standard stations. In the year 1880 there were 30 standard stations, and 88 rain-gauge stations. But the increased number of stations by no means represents the real progress that has been made. It must not be forgotten that, from the small funds at the disposal of the Commissioners, it was impossible to remunerate the observers for their services, and it is no small encouragement to think that so many persons have been found who are willing and able to undertake the somewhat exacting duty of recording regular and long-maintained series of meteorological observations. But the fact that these observers are unpaid, and that many of them were, at the same time, untrained and inexperienced, placed the Commissioners often in considerable difficulty. Valuable instruments were committed to the care of distant observers; but it was impossible to ascertain whether these instruments were properly mounted or properly observed. Indeed, the anomalous returns sometimes received showed that considerable errors did exist; but whether in the instruments themselves, or in the mode of observation, it was not always easy to say. Thus, for example, it was not unfrequently found that the wet-bulb thermometer was recorded as reading higher than the dry-bulb. Still more difficult to explain were the returns from one station where the minimum

thermometer was often recorded higher than the maximum; a
those from another station, where months of dry weather we
recorded when, from other information, we knew that considerab
quantities of rain had fallen in the district. It was also suspecte
that the true actual range of temperature in many localitie
greatly exceeded that recorded, and that therefore there wa
reason to believe the thermometers were not properly exposed. I
fact, it became generally evident that unless some control could b
exercised by the Commission, and unless some effective system o
inspection could be instituted, the work of the Meteorological
Commission was merely wasted. On the representation of the
Commission, Mr Sprigg at once placed an additional annual vote
of £250 on the estimates to provide for the annual inspection of
the stations; and thus, for the last two years, nearly every one of
our numerous stations has been visited by Mr Fry, the indefatigable
Secretary of the Commission.

Mr Fry's reports form the best justification of the action of the committee. Many extraordinary causes of shortcoming were discovered. Thermometers were found in unsuitable exposures. Some indeed were comfortably ensconced in rooms or closets of the observers—presumably for protection from heat and cold. Large index errors of barometers and thermometers were found. Anemometers were placed where the winds of heaven could hardly reach them, or only by eddies giving no indication of their true direction and velocity. Rain-gauges were found improperly placed, some observers going so far as to keep them indoors, only putting them out when they thought it was going to rain! It is hardly necessary to add that this extreme care of the instruments was not conducive to our true knowledge of the rainfall in that locality. It was in contradistinction, however, to that of one remarkable observer, whose rain-gauge was found riddled with bullet holes, testifying more to his skill in pistol shooting, for which pastime he had used his gauge as a target, than to his devotion to meteorological pursuits.

I hope that in quoting these cases I shall not be understood by any of my audience to mean that I cite them as average instances of the condition of the meteorological stations. This is far from being the case. Many of the stations, indeed, were admirably managed, and at nearly all of them the visit of the Secretary was gladly welcomed.

The observers, as a rule, took the deepest interest in his visit, and have since availed themselves of his instructions and suggestions so completely as to give to their work a new value and a high importance.

I repeat that it is a most hopeful prospect for the future of this Society that there are now in South Africa more than one

hundred persons devoting themselves, without fee or reward, to a scientific work; and where so many have been so easily found, I doubt not that there are many more who, with opportunity and instruction, will devote some of their spare time to science.

I do not hesitate to say that the Government of this colony is to be congratulated on the possession of a system of meteorological records, at once efficient and highly economical, by which, in course of a very short time, the most valuable information will be secured as to the climate of the country and its broader meteorological laws. As a special practical consideration offering an immediate and direct return, I would point to the demand amongst medical men in England for reliable records of the thermal and hygrometric conditions of various localities in this colony. South Africa becomes a daily increasing resort for patients affected by pulmonary disease, and it is only by such records as those obtained by the meteorological commission that the best localities can be certainly ascertained. But the work of the commission is by no means yet complete. I hope to see the time when two or three standard observing stations, with self-recording instruments, will be created and maintained, at least for several years, for the purpose of ascertaining the laws of the diurnal change of temperature, moisture and pressure in various parts of the colony. The time for their establishment has not arrived yet, but we shall soon be in possession of the necessary data for selecting the most desirable localities for this purpose. The laws of the winds of South Africa have not only a local but a general importance in the meteorology of our globe, and I am happy to state that the first steps have already been taken to provide accurate means for their determination. Three self-recording wind-gauges have been ordered: one will be placed on Robben Island Lighthouse, one at Port Elizabeth, and one at East London, and from their records the most valuable data will be procured. These instruments were not ordered with an immediate view to the purposes I have described, but as part of a scheme I had formed for obtaining more accurate knowledge on the important subject of South African tides. I need not point out the extreme value of an accurate knowledge of the tides on a coast where so much has been, and so much is being done, in the way of harbour improvement.

I represented to the Table Bay Dock Board, to the Port Elizabeth Harbour Board, and to the Commissioner on behalf of the East London harbour works, the great importance of establishing an accurate self-recording tide-gauge, accompanied by a barometer and anemometer, at each of these stations. My representations were met in the most liberal spirit. The instruments for Table Bay have already arrived, and within a few days steps will be taken for their erection. The similar instruments for Port Eliza-

beth and East London are already on their way, or, probably before this, have reached their destination.

Not only will the observations by these instruments permit actual predictions of the tides to be made, but they will lead to results of great general scientific interest, when discussed in connection with the observations of tides in other parts of the world. Amongst these results we may look for a determination of the mass of the moon, more definite information as to the rigidity of our globe, and some approximation to the amount of retardation of the earth's rotation by tidal friction.

Time Signals.

Still more intimately connected with my daily work is the development of the system of time signals. Daily, a time ball is dropped at the docks at noon, and, at one o'clock, a gun is fired at the castle by a current from the Royal Observatory. The latter current, at the same instant, drops a time ball at Simon's Bay and one at Port Elizabeth. Within the past two years this system was extended to Kimberley, where a time ball is now dropped daily at one o'clock, Cape mean time; and arrangements are being made for extending the same system to Natal, for the purpose of dropping time balls and firing time guns at Pietermaritzburg and Durban. Arrangements had been made, and a time ball ordered, for use in Pretoria, but I very much fear that, in present circumstances, its use will not be continued.

Harbour Clock.

Another useful system of time signal which I am about to establish, with the liberal co-operation of the Harbour Board, is a controlled clock at the dock entrance. This clock will be in electric connection with the mean time clock of the Observatory, and its pendulum will be compelled to swing synchronously with that of the Observatory clock, by a current sent at each alternate second from the latter. But the dock clock is also in itself an instrument of very high precision, so that, even in the event of the failure of the current or the breakdown of the connecting wire, the Harbour clock will alone be capable of carrying on the time, without sensible error, for a very much longer time than our energetic friend, Mr Sivewright, will require to repair his line. The Harbour clock will also report itself automatically to the Observatory once every minute, and the Observatory clock will report itself by a signal, visible on the face of the Harbour clock, once every minute, so that a ship captain desiring to rate his chronometer can always be certain, not only that we are aware at the Observatory of the accuracy or otherwise of the Harbour clock, but he can also test

r himself whether the Harbour clock and the Observatory clock re in coincidence.

Longitude Determinations.

As a matter having high scientific interest, I may mention the erations now in progress for making an accurate determination the difference of longitude between Aden and the Cape. In 875, in connection with Lord Lindsay's transit of Venus expedition Mauritius, and with the co-operation of Dr Löw, of the German enus expedition, and of Dr Auwers, of Berlin, I connected the ongitudes Aden—Suez, Suez—Alexandria, Alexandria—Malta, nd Malta—Berlin. The chain was completed by the accurate onnection Berlin—Greenwich by the results of various European ngitude operations. It therefore only remained to connect Aden ith the Cape to complete the accurate determination of the longi- ude of our observatory. The operation divides itself primarily nto two parts, viz., the submarine section Durban to Aden, and he overland portion Cape Town to Durban. My first assistant, Mr Finlay, is now on his way to Aden, having successfully es- tablished his observatory at Durban, and exchanged the necessary signals on six nights with the observatory here. Signals have also been exchanged on one night from Delagoa Bay. To-night we expect to exchange signals with Mr Finlay at Zanzibar. These last operations which I have described, are only subsidiary, de- pending on the intermediary operation of an observer at Durban, but they are amply exact enough for determining the longitude of places for hydrographic purposes, and the results will be highly useful for purposes of geography and navigation.

Early next month, however, Mr Maclear and I will leave for Durban, there to commence the more delicate and difficult work of exchanging signals through nearly 3000 miles of cable connecting Aden and Durban. Every clear night, when observations for time have been secured both at Durban and Aden, signals will be ex- changed during two or three weeks. So feeble is the signal trans- mitted, after encountering the resistance of so long a cable, that it is incapable of acting on any of the speaking instruments generally employed. Recourse must be had to the galvanometer of Sir William Thomson, which consists of an exceedingly light mirror, upon the back of which a very light strip of magnetized steel, generally a piece of small watch-spring, is fastened, the mirror and magnet together weighing only a few grains. This mirror is suspended by a single fibre of silk in the centre of a coil of wire, through which the current, from the cable, is made to pass. This current is sufficient to deflect the delicately suspended magnet, and with it, of course, its attached mirror. If a beam of light is thrown upon the mirror from a lamp, this beam will of course be

reflected by the mirror, and will form a spot of light on any screen interposed in the reflected ray. The reflected ray will move through twice the angle by which the mirror may be deflected by the signal, and as the distance of the screen from the mirror can be varied at pleasure, the small motion of the spot of light produced by the signal can be magnified almost to any required extent. Each night, then, the signals will be carefully sent, precisely at each half minute, by the observer at Aden, and the instant of movement of the spot of light will be recorded by the observer at Durban. Then the observer at Durban will, in turn, send similar signals, and these will in turn be noted by the observer at Aden. Thus on each night the observers will be able to compare their clocks as if they were side by side, and their respective errors on local time being ascertained, for each place, by astronomical observations, the difference of longitude between Aden and Durban will become known. The accuracy of each night's work will probably be within one-tenth of a second of time, and the mean of all the nights will probably be within one-fiftieth of a second of time of the truth, corresponding, when measured on the earth's surface, with a distance not exceeding the breadth of the hall in which I now speak. Time will not permit me to notice here the many delicate points which have to be attended to, and the steps to be taken for the elimination of what is called *personal equation*, or what you will more readily understand if I express it by the difference of *habit* of each observer in noting signals and determining time. But all these necessary precautions will be strictly carried out, with the most minute care, and before the end of this year we may expect to have a determination of the longitude of the Royal Observatory sufficiently exact for the most refined requirements of science. The determination of this longitude will enable me to prepare for publication, in a completely reduced form, a vast mass of highly important observations which have been made at the Royal Observatory during the last fifty years, and which, until this longitude had been accurately determined, could not be utilized in the most complete manner. As a matter of secondary importance the latitude and longitude of Durban, and probably of Port Elizabeth also, will be fixed with extreme precision, and the latitudes and longitudes of Delagoa Bay, Mozambique, and Zanzibar with far greater precision than they have been known before, and certainly with more accuracy than the most refined requirements of navigation demand.

Astronomy.

Coming to the observatory work proper, I must mention in the first place the completion within the year of Mr Stone's Great Southern Catalogue of Stars. This catalogue gives accurate

places of all the stars in the Southern Heavens down to the seventh magnitude, which are not visible from Northern Europe. There are in all more than twelve thousand stars in the catalogue in question; each star is observed at least three times, both in Right Ascension and Declination, and the whole results are reduced to the mean epoch 1880. The publication of this work marks an epoch in the astronomy of the Southern Hemisphere, and bears striking testimony to the energy and unity of purpose which marked the directorship of my esteemed predecessor. I had the pleasure of seeing an advance copy of this work when in England, and within a very short time it will be issued to the public. Waiting only for comparison with the work of Mr Stone's is a catalogue, the computation of which is just completed under my direction, containing observations of 5000 stars south of the equator observed under Sir Thomas Maclear between the years 1848 and 1852. This catalogue will have considerable value in settling questions connected with proper motion.

During the past two years a good deal of attention has been directed at the Observatory to the observation of occultations of stars by the Moon. These observations when properly reduced, will be placed in the hands of Professor Simon Newcomb to aid in his new discussion on the motion of the Moon. The clear skies at the Cape are very favourable for such work, and three times as many occultations per annum can be observed here as can be observed in England in the same time.

A catalogue of stars, specially for comparison with northern observatories, has occupied much of our time with the meridian instruments. This catalogue will contain about 500 stars visible both in Europe and at the Cape. The stars are observed here with great care, and generally on twelve different nights in each co-ordinate, so that their places will be determined with high precision. The same stars are also being observed at northern observatories, and the comparison of the separate results will give much information on the great question of astronomical refractions; a question the solution of which was one of the primary objects for which the Observatory was founded.

Last year from this chair I endeavoured to make clear to you the history of a problem, upon which I had been for some time engaged, viz., in the determination of the Earth's mean distance from the Sun. I tried to make clear the importance of the problem to the progress of astronomy, and the various methods, including my own, by which a distance of about 93,000,000 of miles resulted as the most probable. Since then I have undertaken the attempt to extend our knowledge of the dimensions of creation by determining the distance of some of the fixed stars. You may remember how I showed that, 1st:

By comparing the standard yard with the apparatus used in measuring base lines, the exact distance between the terminal points of these base lines in terms of the standard yard was determined. 2nd: How, by the process of triangulation, the distances between points separated by many hundred miles on the earth's surface were determined. 3rd: How, by astronomical observations, the proportion which these distances bore to the Earth's circumference was ascertained. 4th: How, by the combination of many similar series of such operations, an accurate knowledge of the form and dimensions of the Earth was arrived at. 5th: How, by employing this knowledge to find the distance between widely separated stations on the Earth's surface, or by observing from one fixed station on the Earth, and employing the Earth's rotation to transport the observer a known distance of 7,000 or 8,000 miles through space, between his observation of the evening and morning, a new base line was thus secured, by which, with an exceedingly delicate process of triangulation, the distance of Venus or Mars, or of one of the minor planets was determined. And 6th and lastly: How our knowledge of the proportional distances of the planets enabled the astronomer from such determinations to deduce the true distance of the Earth from the Sun. I am now engaged in an endeavour to utilize this huge base line, the distance of the Earth from the Sun, in the still more difficult problem of determining some of the distances of the fixed stars. In an interval of six months, the Earth, by its movement round the Sun, is obviously transported to points in space distant from each other by twice the Earth's distance from the sun. Hence it is only necessary to measure the change of a star's apparent place in the heavens, as viewed from two such widely-separated points, in order to determine its distance. But so enormous are the distances of the stars that probably none of them will appear displaced by an angle amounting to one second of arc, even when viewed from standpoints so widely apart as 186 millions of miles. Or, to put the matter in words that will convey a clearer impression to your minds, the nearest star will not appear to shift more than the breadth of a three-penny piece viewed at a mile distant. Or, to put it still otherwise, the huge orbit of the earth, 186 millions of miles in diameter, will not appear larger, to the inhabitants of the nearest fixed star, than a three-penny piece would appear when placed at the distance of a mile from the eye. The problem is obviously a difficult one, but its extreme interest justifies any labour and care that can be bestowed upon its solution. I have been fortunate in securing the heliometer, with which my previous researches on the Sun's distance were made; and also in obtaining the assistance of an able and enthusiastic friend—Mr. Elkin. The work advances satisfactorily. So far as

we are able to judge, the result of a single night's measures appears to fix the position of a star with a probable error not exceeding one-tenth of a second of arc, and the mean of many nights will probably give the required accuracy. Before the end of 1882, we hope to have arrived at some interesting conclusions as to the result of our labours—results which, though small compared with the enormous field of work before us, yet cannot fail to have some interest, and which we hope will conduce somewhat to our knowledge of the dimensions of the sidereal system.

During the past two years two remarkable comets have visited our southern skies. The first of these was observed on the 1st February, 1880, by several persons in this colony as well as in Australia and South America. The interference of Table Mountain prevented observations being made from the Royal Observatory, but, by the kindness of Mr. Henry Solomon, I was enabled to make observations of the tail from his garden at Sea Point. It was not until February 9th that observations of the nucleus could be secured at the Royal Observatory, but from that evening until the 15th inclusive the place of the comet was determined on each night by observations with the equatoreal. Cloudy weather then set in, and no further observations could be secured till the comet faded beyond the range of visibility of our instrument. At Melbourne with fairer weather it was observed till February 19th. The elements of this comet bear a considerable resemblance to those of the great comet of 1843—both comets were alike remarkable for their very close approach to the sun and for the length and brilliancy of their tails. But from the fact that no observations were secured before perihelion, and that the portion of the orbit that alone could be observed differed little from a straight line, it is quite impossible to obtain elements of high accuracy. The nucleus too was by no means a well-defined point capable of very accurate observation, and thus the results of observation are not so accurate as they would otherwise have been. The comet of 1843 was supposed to have a much longer period than 36 or 37 years, but somewhat similar difficulties occurred in connection with the exact determination of its orbit, and the identification is now found to depend on quantities in the observed places, so minute that it will probably be impossible to be certain of the identity or otherwise from existing data. In the end of May of the present year, during my absence in England, a bright comet appeared in the constellation Columba. This comet was observed with very desirable precision by Dr Elkin with the heliometer, the equatoreal of the observatory having been taken home by me for some needful alterations. From these observations, Dr Elkin deduces elements which are very similar to those of the great comet of 1807—elements which, but for the dis-

cordance of the perihelion distances, would almost prove the identity of the two comets. It is, however, premature to consider the question of this identity more fully. After perihelion the comet passed into the northern hemisphere, where already a fine series of observations have been secured, and the discussion of these observations, in conjunction with those of Dr Elkin, will conduce to results of far higher interest and precision than any that could be founded on one series alone.

Trigonometrical Survey of the Colony.

I would now turn to a subject in which I have taken a very deep interest, but in connection with which I much regret not to be able to report progress. I refer to the state of the survey in this colony. My attention was directed to the subject by Sir Bartle Frere soon after my arrival in the colony, and since then I have given much thought to the matter. After a very full examination into the existing state of affairs, I came to the conclusion that to pursue the present system is wasteful and unsatisfactory, and that it will lead daily to greater and greater difficulties as time goes on. There is no ultimate escape from the rigid process of systematic triangulation, and the sooner *that* is carried out the better and cheaper it will be for the colony. I am not alone in this opinion. The Surveyor-General, the Chief Inspector of Public Works, the Hydraulic Engineer all hold similar views, and the plans which I have proposed and the opinions I have expressed have been endorsed by the Ordnance Survey Department at home, and by Sir Geo. Airy, the Astronomer Royal of England. The necessity for the establishment of standard points over the colony, has been brought under notice over and over again by the Surveyor-General's Department. The fault is not there. It lies with the Government. Like all young Governments, the tendency is towards spasmodic legislation—no provision is made for the gradual accumulation of useful material for work that is not immediately remunerative—a subject is neglected till its necessity presses, then suddenly the need is perceived, and the thing has to be done in hot haste—done as best it may, at whatever cost—and, of course, as in haste, the work is dear and bad. Thus, for example, Government suddenly has application for the purchase of Crown lands in a particular district; the Surveyor-General has orders to survey the district immediately, his orders are to do the work as fast as possible. And so a hurried survey is made, unconnected with standard points, and useless for incorporation in the cartography of the country. Had standard points existed, had a sound uniform system of work been established then each piece of survey done would be of so much

ain, so much towards the ultimate construction of complete and ccurate maps of the colony. As it is, this work is simply wasted; he want of check produces errors, and errors lead to disputed oundaries, and disputed boundaries to endless lawsuits. It vidently follows that the work has to be done over and perhaps ver again, and the final result is perhaps at best a makeshift—a ompromise—a miserable piece of patchwork. Instead of each map, and each part of each map, being a harmonious part of a harmonious whole, you find that the separate diagrams will not fit together, they overlap, they fall short of each other, and leave districts of "no man's land." In proof of what I state it is only necessary to look at one of the district maps of the colony, so far as they have been completed. There are the overlaps and the shortcomings that cannot be got over or patched up in any way. The consequence is, that in all our courts the geometrical evidence goes for very little, and recourse is had to the evidence of prescriptive right—evidence always unsatisfactory and expensive. I met a well-known colonist the other day, who told me that he had been compelled to sell a valuable property that otherwise he did not desire to part with, simply because of the continual worry of lawsuits as to boundaries. This sort of thing simply results because, under the present system, the geometrical evidence is necessarily bad; whereas, under a proper system of check, founded on a sound system of survey, the geometrical evidence must be the most perfect and undeniable. The general principles which I advocated have already been anticipated by the recommendations of your own Government Commission, and there is now before Government a specific scheme, which has received the approval of the chief authorities in this colony and in England. The sale of your Crown lands produces an abundant source of revenue, upon which the triangulation and cartography of the colony should properly fall as a first charge. There is therefore no excuse for further delay. Every year that the work is now postponed means so much additional unconnected survey work done, so much more money thrown away and so many more law difficulties created. I do not propose to dwell on this subject at greater length now. Indeed, it would only be to repeat what I have already written in the Blue-book on the subject. But I do sincerely trust that Government, looking to the responsibilities of the future, and adopting a policy in the matter which is not the wasteful one of providing merely for pressing emergency, but that of wise, economical, and gradual provision against future need, will rouse itself at once and provide in the coming estimate for a commencement of the work.

South African Philology.

Coming now to S. A. philology and ethnology, I may mention first the excellent *Nubian Grammar* of Professor Lepsius, of Berlin, where we find, in an exhaustive introduction, some remarkable ideas and theories, on races and languages of Africa in general and of South Africa in particular. Lepsius maintains, for instance, that the Hottentot race is a production of a cross between the Kushites, who, originally starting from Asia, crossed the Red Sea and wandered along the East African Coast, where they were overpowered by the Bantu or Negro race, and then were either entirely absorbed or amalgamated. He also upholds the theory of the late Dr Bleek, of the relationship of the Hottentot with the Hamitic languages. Professor Lepsius, however, as the London *Times* of December last year puts it:—"Having thus thrown a firebrand into the peaceful kraal of African scholars, will be attacked on all sides and criticized." The final settlement of the question he opens will probably turn upon the true relationship *of* Bushman and Hottentot, viz., whether the Bushman or the Hottentot represents the more ancient type of the clicking languages. If it should turn out in favour of the Bushman we would have the fact that Hottentot which is sexdenoting has developed from Bushman which is not sexdenoting, and Professor Lepsius would thus lose his strongest point of argument. I am glad to state that our newly-appointed Colonial Philologist and Grey Librarian, Dr Theophilus Hahn, is engaged in the solution of the question and that we may shortly expect some light on the matter. A book from his pen, on the religion of the Hottentots, the first treatise on this subject, is in the press, and promises to give new and valuable contributions to comparative Mythology. Professor Fred. Müller, of Vienna, in his *Allgemeine Sprachwissenschaft*, deals in his first volume very ably with the South African languages, and argues in the most emphatical terms against the theories of Professor Lepsius. Abel Havelacque, a French philologist, has a very interesting essay on South African languages, and so has the well-known English philologist, Robert Cust. Professor Robert Hartmann, of Berlin, in his work *Die Völker Africas*, draws a sharp and clear outline of the anthropological and ethnological position of the African races, and in many respects does not agree with Professor Lepsius. He, however, is of opinion that all real African races (the Hamitic excluded—Urafricaner as he styles them) spring from the same black stock. In concluding a glimpse at the workshop of African scholars, one cannot omit to mention such careful and toilsome labourers as the Rev. Kolbe, whose *Herero Dictionary* is now in the press, and the Rev. J. Chalmers, of Graham's Town, and the Rev. Kropf, of the

rlin Mission, who stand in the first rank of Kafir scholars of e Select Committee for the Revision of the Kafir (Amakosa) ble—a work which will prove a golden mine to the comparative ilologist. School and text books, tracts, and other publications the various Bantu idioms, are so numerous that with our nited time I cannot mention them here.

Natural History and Botany.

In the department of natural history and its work immediately onnected with the Society, we find the Hon. C. A. Smith exhibited specimen of the fern *Anemia Dregeana*, found in the Perie Bush, in the King William's Town division; and Mr Bolus remarked that this example was interesting as being the first he had seen from a locality within the limit of the Cape Colony,—the species having hitherto been regarded as peculiar to Natal. Mr Bolus exhibited a plant of the genus *Schizoglossum* that was probably new to science. Mr Trimen exhibited specimens of ten butterflies new to science; he also exhibited the under-jaw of a remarkable and apparently very rare pigmy sperm whale (*Physeter breviceps*). Mr Hugh Munro, who had presented this specimen to the Museum, had seen the entire animal stranded on the beach near Knysna, and described it as about seven feet in length. Mr Trimen also exhibited two specimens of a very singular hymenopterous insect found near Cape Town, by Mr C. A. Fairbridge and Mr L. Péringuey respectively, which he believed to be the long-sought female of *Dorylus helvolus*, Linn. Mr Fairbridge has since found another specimen of the same species, and a smaller specimen of apparently another species. Mr C. Lloyd Morgan exhibited fourteen specimens of *Peripatus capensis*, found by him under stones on the slope of Table Mountain near Rondebosch, and remarked on the habits of this singular animal. Mr Trimen gave a short account of the creature's discovery at the Cape, and mentioned the wide range of the genus *Peripatus*, single species being known from isolated localities in the West Indies, South America, and Australia. He also mentioned the valuable researches of Mr H. W. Moseley, whose paper, published by the Royal Society, established the position of *Peripatus* as a tracheated arthropod of a very generalised, and probably very ancient type. Mr Trimen exhibited two new specimens of birds, *Coracias spatulatus* and *Laniarius atrocroceus*, obtained by Dr Bradshaw in the neighbourhood of the Zambesi, at the junction of the Zambesi and Tschobe rivers.

The following works bearing on the botany of the Cape have been published within the past twelve months:—

1. *Description and publication of fungi*, collected by P. MacOwan, and described by Walchbrenner and M. C. Cooke, in

the *Grevillea*, September, 1880, December, 1880, and March 1881.

2. *Description and figures of several South African fungi* in the *Transactions of Hungarian Academy of Sciences.*

3. *Descriptions of new plants from the Cape*, by Professor MacOwan and N. Bolus, in *Journal of the Linnæan Society*, April, 1881.

4. Publication of J. G. Baker's *Monograph of Aloes and Yucca* in *Journal of Linnæan Societies*, vol. XVIII., the former genus being almost exclusively South African.

5. Publication and figures of several new species in *Botanical Magazine.*

6. Arrangement made for the curatorship of the long-neglected Cape Government Herbarium, the result of life-long labours of C. F. Ecklon.

I come last of all to the consideration of some subjects which suggest themselves as fit and proper for mention from this chair. If in so doing I seem to exceed the limit of authority to which my individual opinion is entitled, I beg you to excuse me on the ground that, as President of a scientific society, I am simply stating some of the results which must inevitably ensue from the neglect of nature's laws, and the non-cultivation of the gifts that God has given to man.

Necessity for Workshop Instruction at Agricultural Colleges.

Some time ago I was present at a very interesting ceremony—the laying of the foundation-stone of an Agricultural College at Stellenbosch. It was an encouraging thing to find that this college was the product—not of a fostering Government—but of a people, for a felt need. That the project was set on foot and the necessary funds raised by private subscription. Government did well to step in with welcome aid; and to help those who helped themselves. I found too an excellent spirit abroad; a desire among young men—sons of farmers—and farmers themselves to be, to learn as much as possible of the scientific side of their business; to study especially agricultural chemistry; and on the whole, perhaps a tendency too much to specialize their education. But I found also a spirit abroad which is by no means a desirable one. It was this:—That manual work is derogatory and degrading. Each and all of these young farmers was willing, and occasionally able, to talk fluently by the hour, about Spectrum Analysis, or the Atomic theory, yet not a single one of these fine young gentlemen knew how to make a screw or file a pin, and might have been dreadfully insulted were he asked if he could do so. It is high time civiliza-

ion had so far penetrated South Africa as to dispel these silly notions. I know few sadder sights than to visit some of the larger and more distant farms and to find valuable reaping machines or good pumps cast aside and useless for want of a screw or pin that an hour's work at the time would have replaced, but which, now neglected and rusty, remain costly monuments to the ignorance of their owners. Now here, where agricultural labour is scarce and dear, where farms are large and far apart, where therefore the use of machinery is specially valuable, and where there is no neighbouring village blacksmith to apply to, the importance of a knowledge of the use of tools is trebly important to the farmer. Is it not ridiculous that this farmer or his son should consider himself degraded by such knowledge and ability, and is it not right that the education of a young farmer here should include practical instruction in the use of tools, and that each farmer should have his workshop? The time is gone when the cultivation of the mechanical arts can be considered beneath the dignity of a gentleman. It is very mainly to their means that we must look for the progress of civilization, and it is the masters of these arts that are amongst those we most look up to and honour.

"Non arte sed marte"

is a motto that has passed away, and my grand old friend Nasmyth has rightly changed his old family motto to that of

"Non marte sed arte"

and his crest to that of his steam-hammer—typical of a nobler conquest over the forces of nature than even belted knight of old won for his lady-love or his king. For my own part, I look upon the two years of my life which I spent in a workshop as probably the most valuable part of my education, and I doubt not that the young South African farmer would reap a like advantage from like instruction. I would advocate, then, the early establishment of a workshop, and workshop instruction at the Stellenbosch Agricultural College, and generally in the educational institutions of the colony. We should then hear less of the difficulties of irrigation, and we should find those scorching summer winds turned to account for the watering of the parched soil; a pump and wind-mill would cease to vex the farmer, and would become his best friend; we should cease to live under the disgrace, that, in this broad country, with its wide uninhabited plains, with its rivers and natural springs, we cannot or do not grow enough of grain for our own consumption.

Scab in Sheep.

I hope, too, that the agricultural course will include a proper course of lectures on Veterinary Science, and that the young

farmers will be roused to some sense of their duties in t respect. The terrible neglect that exists in the matter of ordi sanitary precautions in agricultural matters struck me very m on a trip I made in the country last year, and it struck my bro —an Australian farmer—who accompanied me, still more. came upon flock after flock of sheep affected—some of them the most terrible manner—by scab. The lands were unfenced, diseased animals were allowed free access to the adjoining far so that not only was nothing done for the poor animals to rid th of the awful pest, but it was carried from flock to flock a allowed to spread till its ravages will prove the ruin of woo growing in the colony. In Australia a severe Scab Act has be in force for years. Inspectors are appointed in districts. Whe ever a particular farm is affected with scab a cordon is draw round it, no access is permitted to it, and no stock permitted leave it till the last vestige of the disease has been eradicate And what is the consequence? The disease has disappeare the quality of wool has improved, and, when you can barely g 9*d.* or 10*d.* for your colonial wool, the Australian brings 1*s.* 3*d.* t 1*s.* 6*d.* per lb. There is no reason why the quality of your woo should not equal that of Australia, nor that the quantity, sheep for sheep, should not be as great. It merely requires that you should display the same energy, the same care and skill in breeding, the same attention to the health of the flock. I trust these words may call attention to a subject which is so intimately connected with the progress and prosperity of the colony, and that Government will see its way to bring in some efficient Act to stamp out this terrible pest.

Sanitary Condition of Cape Town.

Whilst on the subject of sanitary questions, I cannot but refer to the condition of Cape Town. Returning by road, as I often have done, from the evening meetings of the Society, I can speak feelingly of the terrible state of the drainage of some parts of the town. Passing the Castle no words can express the horrible odours that fill the air on a quiet night. It needs no knowledge of science to tell whence these proceed, and but little to point to the inevitable consequences of neglected or ill-performed drainage. Cleanliness is next to godliness, and the punishments that Heaven metes out on earth to those who neglect it are typhoid fever and its allied diseases. There is no manner of excuse in these days for the neglect of ordinary sanitary precautions. Right well do we know, by the sad accumulated experience of civilized life, what to do and what to avoid. And yet I do not hesitate to say that there is not a single sanitary law that is not outraged, hardly an ordinary sanitary precaution that is not neglected in this same

ity of Cape Town. Blessed beyond all ordinary measure with very advantage of natural situation, provided with a boundless atural water supply, with a natural fall for the outgoing of its rains, one half of the city remains undrained, and such drains as here are, untrapped, unflooded, and in bad repair. The refuse of ish near the bottom of the principal street remains abroad, reeding pestilence, instead of being used to enrich the soil; the treets are streets of mud, and from their surface fill the air with ed, abominable dust stirred by our much decried but only sanitary riend, the south-east wind.

Charles Kingsley says, preaching in 1849, when the cholera had a second time invaded England:—"When they saw human beings dying by thousands, they all got frightened and proclaimed a fast, and confessed their sins, and promised repentance in a general way. But did they repent of and confess the carelessness and laziness and covetousness which fill every corner of the great cities with slaughter houses, over-crowded graveyards, undrained sewers? Not they. To confess their sins in a general way cost them a few words, to confess and repent of the real particular sins in themselves was a very different matter; to amend them would have touched vested interests, would have cost money, would have required manful fighting against the prejudices, the ignorance, the self-conceit, the laziness, the covetousness of the wicked world, so they could not afford to amend of all *that*." "So the filth of our great cities was left to ferment in poisonous cess-pools, foul ditches, marshes, and muds; for one house or sewer that was improved a hundred or more were left just as they were in the first cholera; as soon as the panic of superstitious fear was past, carelessness and indolence returned. Men went back, the covetous man to his covetousness, and the idler to his idleness. And, behold, sixteen years are past and the cholera is as bad as ever among us."

Do these words, spoken more than 30 years ago with terrible significance in England, bear no significance spoken now in Cape Town? Does not every added house, every neglected sewer make Cape Town more liable to the danger hanging over it, and hasten the time when the Angel of Death will surely visit these streets, and when his messengers typhus, cholera, or small-pox, as hideous guests will enter your homes and strike down your nearest and dearest for the punishment of your crime of filth. This is no exaggerated statement, no false alarm; it is plain, hard, scientific fact. Where small-pox has come before, it can and will come again. Some period without south-easters, some neglected quarantine precaution, some tainted garment, and the germ of the disease is introduced—introduced into a hot-bed ready prepared, with an awful suitability, for its propagation. Then the cry will

arise, and the cowards and the ignorant and the men who chiefly to blame will seek their country houses, and shiver shriek at the work of their own hands—and call it a visitatio Providence. And who are these men? The answer is not far seek. It is those who year after year seek for places at Council Board with a cry of a false economy; those who tr upon the greed, the prejudice and the selfishness of an ignor constituency by declaring that this and that sanitary operation not required, that there is plenty of time, that we are very well we are, and promise above all things that the taxes shall n be increased. These are the men who have brought this town the terrible condition in which we find it to-day. I have n hesitated to speak out freely and boldly on this subject. If the men do not know the truths I have stated, do not know that th surest protection from the diseases I have described is to b found, less in your quarantine regulations than in cleanliness, i vaccination and efficient drainage. If, I say, these men do no know these things, then, as President of this society, *I do not fear to tell them.* But if these men *do* know these things, if local opinion cannot be roused, and ignorance or self-interest or self-conceit be still too powerful, it is time that Government should bestir itself here, as it was compelled to do in England, and appoint a Sanitary Commission. Such a Commission has power, when it finds a Municipality that will not perform the necessary work, to interfere and perform it for them in the completest manner, and charge the costs to the community for which the work is done.

Popular Lectures.

In concluding this somewhat rambling address I wish to allude to a subject much more immediately connected with the work of the society than those subjects into which I have wandered. In the present winter an attempt was made to rouse some greater general interest in intellectual subjects by the establishment of a course of public lectures on science under the auspices of the society, but I regret to say that the attendance was by no means what it should have been. The lectures were admirable, the subjects chosen peculiarly interesting, and the lectures were given by men more or less specialists in the subjects with which they dealt. I ask you, ladies and gentlemen of Cape Town, who have met here in such goodly numbers to day—Is this right? Is it fair to the Society? Is it fair to yourselves? Is it that you are to remain open to the accusation that your women can only dance or read novels, and that the thoughts of your men are limited to diamonds and feathers, to wool and to hides? We pipe to you a nobler music, and you will not dance; we ask you to exercise the

asoning and the observing faculties that God has given you, and t entirely to fritter them away in worthless occupat on. I am illing to believe, and I do believe, that the real cause of the all attendance at the lectures in question was that their ttention and character were not properly understood. There was notion abroad that these lectures were unintelligible to the initiated, and uninteresting to any but specialists or to persons of revious scientific training. I assure you this is a great mistake. hese lectures were founded with a view to wake a new interest in cience in Cape Town and the colony, with a view to interest any who probably never before supposed that science was nteresting; and chiefly in the hope that this awakened interest ould lead some, in whom the spirit of science lay dormant, o rouse themselves to active work in a new and delightful field. t lies with you, ladies and gentlemen, to say whether these ectures are to be continued. If, after this explanation of their bjects and aims, the attendance at the lectures is largely increased, and if, by continued attendance, you show that they possess an interest for you and are doing good, then we can promise you a continuance of them. But if not—if the meetings are as small as formerly—then must we discontinue them. I hope for your credit that it will not be necessary to do this, but that the Society helping you and you helping the Society, a great and mutual benefit will be the result.

And now, on resigning this chair, I would beg to congratulate the Society on its having persuaded Mr Gamble to take the office of President. His high mathematical acquirements, his wide general reading, his energy, his power of organization, and his knowledge of business alike point to him as one under whose direction the work of the Society must flourish and progress. I trust and believe that this will be so, and that this Society, though now but a young and tender plant, will yet grow up into a great, a goodly tree, and bring forth much fruit unto perfection.

LIST OF ORDINARY MEMBERS

OF THE

South African Philosophical Society.

JULY, 1881.

Abercromby, A., M.D.
Arderne, H.M.
Ayers, F.
Bain, T.
Bindley, Rev. F. W., M.A.
Boettger, G.
Bolus, H., F.L.S.
Bond, Rev. S.
*Bright, H. E. R., F.G.S.
Buchanan, E. J.
Burrowes, F. W.
De Smidt, A.
De Villiers, Sir J. H., Kt., C.J.
De Villiers, J. H.
Dickson, W. W.
Dunn, E. J.
Du Preez, H. P.
Eaton, C. R.
Ebden, Hon. A., M.L.C.
Ebden, Dr. H. A.
Ebden, J. W.
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*Fforde, J., C, E.
Fisk, Rev. G. H. R., C.M.Z.S.
Frere, H. E. Sir Bartle, Bt., F.R.S. &c.,
Friedrichs,—
*Finlay, W. H., B.A., F.R.A.S., *General Sec.*
Fuller, T. E., M.L.A.
Fuentes, F. S.
*Gamble, J. G., M.A., M.I.C.E., F.M.S.
*Gill, David, LL.D., F.R.A.S., *President.*
*Guthrie, F., LL.B.
Hahn, Dr. D.
Hahn, Dr. Theophilus
Hawthorne, W. T.
Jenour, A. C.
Jerram, S.
Kitching, Dr. C. W., M.B.
Kilgour, G., M.I.C.E., F.R.A.S., F.R.G.S.
Knox, E. B. J., Assoc. I.C.E.
Lewis, C. E.
ghtfoot, Rev. Canon, B.D.
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McLoughlin, P.
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McOwan, Prof.
Marquard, L.
Maskew, F.
Matson, R. R.
*Merriman, Hon. J. X., M.L.A.
Morgan, C. Lloyd.
Noble, J.
Ogilvie, Rev. Canon, M.A.
Oakley, H. W.
Palgrave, W. C.
Redelinghuys, J. H.
Risler, Captain T.
Rutherfoord, F. F.
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Saunders, H. W., M.D.
Scanlen, T. C., M.L.A.
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Schunke, H. C.
Shaw, Dr. J., F.L.S.
Silberbauer, C. F.
*Sivewright, J., M.A., C.M.G.
*Smith, Hon. C. Abercrombie, M.A., *Treasurer.*
Solomon, S., M.L.A.
Stagg, Capt. G. E. O.
Stegmann, Rev. G. W.
Stevens, C. M.
Stewart, Dr. P. G.
Tait, M. M.
Tennant, H., M.L.A.
Trimen, R., F.L.S., F.Z.S.
Tweed, A.
Tyson, [illegible]
Upington, Hon. T., Q.C., M.L.A.
Wessels, J. C.
Wiener, J.
Wilson, R.
Whitton, J.
Watermeyer, B.
Young, E. W.

Those marked * are the present Members of the Council.

THE TRANSACTIONS

OF THE

South African Philosophical Society.

XV. *Notes on the Soils and Manures suitable to the cultivation of the Vine at the Cape.* *By* F. S. FUENTES.

[Read Feb. 23, 1881.]

I WISH to submit to the consideration of this meeting a few remarks upon the soils and manures used by viticulturists in this Colony, which I hope will lead to our receiving from other members of this Society who have been longer in the place and are better acquainted with this subject, more information than that which we now possess, which I am sure will prove interesting and important.

During the time I have been in this Colony my duties have been to show to the wine farmers the systems adopted in Europe in the general cultivation of the vine, the manuring of different soils for same, and wine making. I have for this purpose visited almost every district in the Western Province in which the vine is cultivated; unfortunately I have not been able to make any special analysis with which I could illustrate some of my remarks, and therefore can only call your attention to what I have seen and heard of the mode of viticulture in this Colony, and suggest a few remedies, which, if adopted, would prove I believe very advantageous to the interest of those engaged in this industry and to the Colony at large.

It is hardly necessary for me to say that some of my friends, when I was leaving Europe for this Colony, tried their utmost to persuade me that my coming to it was a mistake, as the Cape Colony could not produce wines fit to drink; and since my arrival here, gentlemen of very great experience in this industry have said

the same to me, giving as their reason that the climate was against this country ever being able to produce wines which could compete with those of more favoured countries; they assert that the rays of the afternoon sun, either direct or reflected, are too powerful, and scorch or burn the fruit before it becomes properly ripened. Though this may apply to some vineyards already planted in such places as the Paarl, Wellington, and Malmesbury, yet I think that the fault should not be laid to the climate, but to the viticulturists themselves, for having selected sites on which they ought to have known that the fruit would suffer thus; and also for having pruned their vines when young in an improper manner. Let them plant their vines on sites well sheltered from the rays of the afternoon sun, which has proved so detrimental, and prune the vines when young, so that the stumps are at least eighteen inches from the ground, to counteract somewhat the reflected heat, and I feel sure this source of complaint would cease.

I am sorry to have to say that although viticulture is the greatest industry in this part of the Colony, yet, with very few exceptions, its rudiments, as practised in Europe, are almost unknown here.

I have found some vineyards planted on soils which hardly possess any of the necessary ingredients for the proper fertilization of the vine, and the proprietors complain of the crops being small, as the fruit will neither set properly nor ripen well; had they taken the precaution, previous to planting the vines on such soils, to get them properly analyzed, they would have found that the soils were not adapted for the cultivation of the vine, and would have saved themselves great expense and trouble.

From very late information we know that there are in this country large tracts of land well fitted for the cultivation of the vine lying waste; and I believe in some districts not even the fortieth part is cultivated; I have myself seen many hundred acres of such soils as chalky, siliceous, aluminous and magnesian on granite mountains and volcanic and alluvial territories, with nothing but bush growing upon them, and which, for the purpose of viticulture, are the best; but ask any proprietor if the soil of his vineyard is any of the above, and, as I have said before, with very few exceptions, he will tell you he does not know; ask him what kind of manure he uses for the different soils, he will say he has but one kind for all, *namely*, stable or kraal manure, and as it is very scarce he is obliged to use it without its being properly rotted, and some, for this reason, have begun to make use of guano. He unfortunately does not know, first, that ammoniacal ingredients are apt to produce too great a vegetable growth of the branches, particularly if there is an absence of the ingredients necessary for the development of the fruit; second, that the exhalations from

fresh manure or guano are likely to adhere to the fruit and impair and destroy its flavour; third, that these ingredients create an excess of albuminous matter, which affects very detrimentally the keeping properties and taste of the wine; and lastly, that sapophrytes, or fungi, growing in rotting vegetable matter, if put in immediate contact with the roots of the vine have a tendency to get from the manure into the bark of the vine and to destroy it.

I consider that the duties of a good viticulturist are to select a proper site, to have the soil analysed to ascertain if it contains the necessary ingredients for the cultivation of the vine, to trenching the ground at least two feet deep, to select the best plants he can obtain out of his own district from that kind which he has seen thrives better in his locality or near about; and as there is no fear of frosts in this country to begin planting immediately after good rains early in the spring, to plant the vines in rows at least four feet apart each way, so as to give the plants as much air as possible, which is very necessary for the fruit becoming uniformly ripe, a most important point for making good wines; and at the same time to avoid exhausting the soil too quickly of its natural ingredients; to prune the vines on the third year after planting, taking care to keep the ground during this time as free as possible from grass, weeds, &c., then to select the best canes for stumps and arms, cutting the part intended for the stump at least eighteen inches high, to avoid the fruit touching the ground or becoming splashed by rain, which generally covers it with dirt, but no higher than three feet, as grapes grown on very high vines never give good wine, on the contrary, their produce is watery and difficult to keep without being heavily fortified with alcohol; and after the vineyard is in full bearing to repeat from time to time the analysis of the soil, to enable him to ascertain if it has lost any of the mineral ingredients so important for the development of the fruit. He must know that there is no soil which will keep all its good properties, mineral salts, &c., for any lengthened period; that these salts are abstracted from the soils by the plants grown on it in the shape of crops, &c., and that it is incumbent upon him to replace as much as he has taken out, so that he may preserve the natural ability of production of the soil. He can easily find out that something is wanting, as, if there is any deficiency of those important mineral salts, his crop will be reduced and the quality of the produce lowered.

The best manure for the vine is stable manure well rotted. To ensure its becoming so it would be necessary to have it exposed to the action of the rain and air; but unless it is transformed into composts this exposure would cause the loss of some of its most valuable components; the way to form the composts is by covering the manure heaps or pits as the case may be (the latter is better)

with thin layers of earth, then moving and remaking these heaps or pits from time to time, adding during this operation a quantity of triturated bones, horn shavings, or any mineral salts that the analysis has shown the soil is in want of for the proper development of the vine. It is needless for me to say that the better a vineyard is cultivated and manured the larger will be the crop, and the quality of the wine will be improved in even a greater ratio.

I have no doubt that, should the Cape viticulturists use every care in the selection of the soils on which new vines are to be planted and cultivate them and those already planted, either in the manner above stated or in any other practised in Europe which may prove more advantageous, the wines of this Colony will compete very favourably with those produced in other countries.

The importance of their so doing is enhanced by the large amount of capital invested in this industry, as, according to statistics, there are in the Western Province alone over one hundred and twenty millions of vines, representing at least twenty millions of pounds sterling.

Also if we take into consideration the great destruction of the vineyards in Europe, America and Australia, caused by the *Phylloxēra Vastatrix*, for which as yet no practical remedy has been found, and which we are assured has not made its way into this country, and the new pest lately discovered in France, Hungary, and Australia, in the shape of fungi or mildew called the *Perispora viticola*, which has also shown great destructive powers, this Colony may find itself one day the greatest wine producing country, and called upon to supply the deficiency in Europe caused by these pests; therefore steps should be taken to induce the viticulturists to adopt the latest improvements, so that, should that call be made, they may be properly prepared to fulfil all demands as to quantity and quality.

XVI. *Summer and Winter Temperature in South Africa*, by JOHN G. GAMBLE, M.A., M. Inst. C.E.

The paper as originally read was explained by the aid of wall diagrams, but a table is annexed giving the principal results from which the diagrams were compiled, and the portions of the paper referring especially to isothermal lines and other details of the maps are omitted here:—

Meteorological observations in the Cape Colony have been somewhat intermittent. During the seven years from 1862 to 1868 inclusive, observations taken at a small number of stations

were reduced and printed, but during the seven years from the end of 1868 to the latter part of 1875, the Meteorological Commission seems to have collapsed, the few stations where observations had been kept up were neglected, and nothing was printed. Since 1875 printed reports giving the results of observations at a limited number of stations have been presented to Parliament every year by the Meteorological Commission.

I have endeavoured to collect together all the temperature observations available both in print and in manuscript. The latter, consisting chiefly of records from Amalienstein (near Ladismith), Clanwilliam, Simon's Town, Somerset West, and Worcester, have required much labour for their reduction, but still some of them, notably the Clanwilliam registers, have been well worth the trouble. Stations, for which less than two complete years were available, have been neglected. The annexed table gives results for twenty-one stations.

The hours of observation before 1875 were generally 9 a.m., 3 p.m., 9 p.m., but after 1875, by the advice of Mr Stone, and in order to suit the convenience of observers, the hours of observation have been 8 a.m. and 8 p.m. In my opinion, the Commission might go a step further, and have observations only at 8 a.m. I am inclined to think that in many cases the observations at 8 p.m. are irregular and untrustworthy. The objections to having only one observation per diem would be partially, if not altogether met, if at a few well-chosen stations in various parts of the country, hourly observations could be arranged for a short period.

The Graham's Town observations were taken by the Royal Engineers, between February, 1854, and January, 1859, the hours of observations, 9·30 a.m. and 3·30 p.m. Maritzburg is given from results presented to the Meteorological Society of England by Dr Mann. Durban (Natal) is given from results published during the last five years by the editor of the *Natal Colonist*.

Mean temperature is a somewhat difficult thing to ascertain correctly. Sir Thomas Maclear was of opinion that the mean temperature is very nearly equal to the half sum of the daily readings of the maximum and minimum thermometers, and this view has been held by many meteorologists in various parts of the world. In fact, till lately, mean temperature has generally been determined in this way. Although there is much trouble with maximum and minimum thermometers, both instruments, especially the latter, being liable to get out of order, yet the convenience to an observer of not being closely tied to an exact hour of observation is a great recommendation in their behalf. But the hourly observations taken at the Royal Observatory, as well as accurate observations elsewhere, show that the half sum of maximum and minimum readings is a very rough approximation to the mean

temperature. As will be seen from the annexed table, the present results do not bear it out. And, indeed, the curve of temperature is by no means so symmetrical that the mean of all the readings taken at short intervals should be equal to the half sum of the greatest and least. In the daytime, the curve is a tolerably symmetrical wave, but after sunset temperature falls steadily though slowly till just before dawn when it rises rapidly again.

I have endeavoured to get an independent calculation of mean temperature by taking the readings of the dry-bulb thermometer, and correcting them for the hours of observation by means of the table of corrections given by Mr Stone for the Royal Observatory. It is clear, however, that the hourly variation of temperature is different at distant stations from what it is at the Royal Observatory, and especially so at stations far inland, or where there are peculiar local conditions. Unfortunately, as yet no hourly observations have been taken elsewhere. Still, I am inclined to think that this method of correcting by the Royal Observatory tables is generally more accurate than that of taking the half sum of the maximum and minimum.

At Amalienstein, no dry-bulb was observed, so we are obliged to fall back on the half-sum of the maximum and minimum. The Maritzburg observations are given by adding together the observations at 9 a.m., 3 p.m., 9 p.m., and the minimum, and dividing by four. This Dr Mann considers to be a very close approximation to the mean.

The table gives temperatures for summer and winter, summer being taken as the mean of the months December, January, and February; winter the mean of June, July, and August, no account being taken of the other months.

By subtracting the reading of the minimum from that of the maximum we get a measure of the "range of temperature." We may note what a much larger "range" the inland stations have than those on the coast. In summer:—

Clanwilliam has a range of 35 deg. Fahrenheit,

while	Aliwal	„	29	„
	R. Observatory	„	21	„
	Simon's Town	„	16	„
	Mossel Bay	„	14	„
	Port Elizabeth	„	14	„

Along the coast the difference between the minimum and the mean is less than the difference between the mean and the maximum, and also much less than the difference between the minimum and the mean up-country. This is, no doubt, owing to the radiation of heat from the earth into space being checked by the watery vapour in the air. It is well known that the earth cools

very much more quickly on a clear starlit night than it does on a cloudy night. And even if no clouds are present there is invisible vapour in the air which acts like a blanket. Vapour does not check the direct rays of the sun in their passage to the earth so completely as it does the dark rays from the earth in their path into space, so that the day temperature is not so much affected by the vapour as the night temperature. The more vapour in the air, the more blanket, the more check to radiation and the smaller range of the minimum thermometer.

In winter there is also a greater "range" up-country.

	Clanwilliam has a range of		28 deg.	Fahrenheit,
while	Aliwal	„	27	„
	R. Observatory	„	15	„
	Simon's Town	„	13	„
	Mossel Bay	„	13	„
	Port Elizabeth	„	15	„

The great difference between the winter range at Maritzburg and Durban is remarkable. At Maritzburg there are dry winters with hot afternoons and cold nights, and the range is 43 deg. At Durban watery vapour acts as a blanket, and the range is only 14 deg.

With regard to mean temperature in summer we may note the comparatively low summer mean temperature of Natal as well as of the north-east of the colony and the Orange Free State, mean summer temperature at these places being 70 deg., while Worcester, Amalienstein, and Graaff-Reinet have 75 deg. and Clanwilliam 80 deg. This is no doubt chiefly due to the fact that Natal and the north-east have summer rains. These affect temperature in two ways; first, the rain-clouds form a protection against the direct radiation of the sun, and secondly, the evaporation from the wet ground cools the air.

The winter minimum, or "before dawn" temperature, is very much lower up-country than along the coast. This is mainly owing to the proximity of the ocean, and probably also of the warm L'Agulhas current. Here we see that Clanwilliam, Aliwal, Bloemfontein, and Maritzburg are all under 40 deg., while Simon's Town, Mossel Bay, Port Elizabeth, and Durban are over 50 deg. Simon's Town is remarkably high, being over 52 deg., while Wynberg is 48 deg., and the Royal Observatory 47 deg. In this case the L'Agulhas current no doubt is at work, the seawater in Table Bay being, as is well known, colder than the water in False Bay. In fact, a naval captain reported to the Meteorological Society of England a difference of 15 deg. Fahrenheit between the two—Table Bay being 52 deg., False Bay 67 deg. The height above the sea is important in all cases, as radiation goes on quicker from

places high above sea-level than from places at a lower elevation. But height above the sea will not explain the cold winter nights at Clanwilliam, for Clanwilliam is only 300 feet above sea-level. The dryness at Clanwilliam is probably the cause.

With regard to summer maximum readings, we find that the ocean, which made the winter nights warm at coast places, makes the summer afternoon cool.

Clanwilliam, Maritzburg	show the highest reading,	91	deg. Fah.
Nel's Poort	has the reading	89	„
Aliwal, Graaff-Reinet, Amalienstien	have readings	88	„
The coast temperature is about		80	„
Port Elizabeth	being	77	„
Mossel Bay	„	79	„
Durban	„	81	„

The summer minimum, or night temperature, is also interesting, the before dawn temperature at Simon's Town being 64 deg. in summer, while at the Observatory it is 58 deg., and at Wynberg 57 deg. Thus, if any one wants cool nights in summer time, he should not go to Simon's Town, but rather to Clanwilliam or King William's Town. The same may be said of Port Elizabeth, where the summer before dawn temperature is 63 deg., and still more of Durban, where it is 67 deg., while at Maritzburg it is down to 58 deg.

Other curious points may be noticed in the table. Thus, Somerset East has a cooler summer than Graaff-Reinet, but its winter night is warmer. This is no doubt owing to local peculiarities; the wooded Bushberg, rising like a wall to the north of Somerset East, supplies moisture to protect the village both from the direct radiation of the sun and from the loss of heat by radiation during the night. Graaff-Reinet lies in the focus of an amphitheatre of barren hills, which reflect the sun's rays, and supply no moisture to check radiation.

King William's Town and Graham's Town may also be compared. The afternoon is hotter at King William's Town both in summer and in winter, and the night is much colder at King William's Town, being 6 deg. colder in winter and 4 deg. colder in summer. That is to say King William's Town, though it is about the same distance from the sea as Graham's Town, has a more "continental" climate. Height above sea level does not explain this, as Graham's Town is 500 feet higher than King William's Town. Graham's Town is, however, more sheltered.

With regard to the future, we may hope for better records in a few

years. Stevenson cribs are now being distributed to all stations, so that the readings will hereafter be taken under conditions of similar exposure at all stations, a point hitherto sadly neglected. The practicability of establishing hourly observations is under consideration; and, perhaps the most important of all, a yearly inspection of stations has been arranged, which, if persevered in, will enormously increase the trustworthiness of the records.

Table of temperature means for South Africa, from which the diagrams were compiled :—

	Height above sea. feet.	Winter.			Summer.		
		min. deg.	mean. deg.	max. deg.	min. deg.	mean. deg.	max. deg.
R. Observatory	37	47	55	62	58	68	79
Wynberg	250	48	55	65	57	67	80
Simon's Town	100?	52	58	65	64	70	80
Somerset West	100?	46	55	64	59	74	84
Wellington	360	45	54	63	59	71	81
Worcester	794	43	56	65	58	75	86
Clanwilliam	300	38	57	66	56	80	91
Mossel Bay	105	51	57	64	63	69	77
Port Elizabeth	181	51	58	66	63	69	77
Amalienstein nr. Ladismith	3,000?	43	54	65	62	75	88
Nel's Poort	3,100	41	51	66	56	72	89
Graaff-Reinet	2,500	44	56	67	62	75	88
Somerset East	2,500	46	55	63	61	69	79
Colesberg Bridge	3,600	—	44	—	—	74	—
Graham's Town	1,800	45	57	65	60	69	79
K. William's Town	1,314	39	53	67	56	68	81
East London	30	50	58	68	62	65	76
Aliwal North	4,300	33	44	60	59	70	88
Bloemfontein	4,600	36	50	59	63	69	83
Maritzburg	2,100	36	55	79	58	70	91
Durban	130	57	63	71	67	70	81

CATALOGUE

OF

PRINTED BOOKS AND PAPERS

RELATING TO

SOUTH AFRICA.

PART I. BOTANY.

COMPILED BY

PETER MACOWAN, B.A. (LOND.),
DIRECTOR OF THE BOTANICAL GARDENS, CAPE TOWN;

AND

HARRY BOLUS, F.L.S.

CAMBRIDGE:
PRINTED FOR THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY.
1882

PREFACE.

We began to make this Catalogue several years ago for our own personal needs in study. Later, we thought it would be of use to other workers in botany in South Africa, as well as to librarians or managers of public libraries, who might require to know what has been published, and what is accessible in the Colony already. Hence, to a mere list was added in many cases a brief estimate of the value of the works and papers quoted, with other particulars, which seemed to serve that end. More recently the South African Philosophical Society resolved to publish at its own expense, by the aid of workers in different branches of knowledge, a series of catalogues of books and printed papers relating to South Africa. We were asked, and willingly undertook, to prepare the section on Botany.

We are indebted chiefly to Pritzel's *Thesaurus Literaturae Botanicae omnium gentium, etc.*, Lipsiae, 1872—7, for references to all books, strictly so called, published up to 1871, which we do not ourselves possess, or have not been able to see. But Pritzel does not enumerate botanical papers unless separately printed. We have sought for and catalogued these so far as in our power; but certain great fields yet remain ungleaned. Chief amongst these are the Transactions of many learned Societies of the Continent; and amongst serials, the *Botanische Zeitung* of Leipsic, the Regensburg *Flora*, &c. Whatever be the omissions, they are of more importance from a bibliographic than from a scientific point of view, since what is of botanical value is generally reprinted separately at a later date, or is absorbed into some larger work.

In such a compilation as this a rigid consistency has been found difficult. Books containing a reference to one Cape plant

have been quoted, others relating to several have been omitted. To have included every book where a Cape plant is named, would have been to swell the Catalogue enormously, owing to the vastness of botanical literature; and it would have buried much valuable information under a mass of names practically useless. We have preferred to be useful at the cost of an apparent consistency.

Similarly, we have included a few entries relating to the Flora of the South Atlantic Islands. They have little claim to admission save that of convenience; they are too small to stand alone, and not large enough to crowd us here.

We have indicated the Libraries of the Colony, so far as we know them, where the works named are to be found. As regards our own collections we take the opportunity of saying that we shall at all times be ready to allow scholarly use of them.

At some future time we hope to make a supplement to this Catalogue; and we shall therefore be thankful for any information or corrections that may be sent us by botanical students.

In conclusion we have to express our warmest thanks in advance to Mr B. Daydon Jackson, Sec. L.S., who, in the most generous manner, has voluntarily undertaken the troublesome task of seeing the Catalogue through the press in England.

P. M. O.
H. B.

Cape Town, *February*, 1882.

CATALOGUE OF PRINTED BOOKS AND PAPERS RELATING TO SOUTH AFRICA.

EXPLANATION OF SIGNS AND ABBREVIATIONS.

*	signifies that the compilers have seen the work.	
†	„ „	work is not in Pritzel's Thesaurus.
S.Afr.	„	South African Public Library, Cape Town.
P.E.	„	Port Elizabeth „ „
G.Rt.	„	Graaff Reinet „ „
Fairbr.	„	Library of Charles A. Fairbridge, Esq., Cape Town.
MacOw.	„	„ P. MacOwan, Cape Town.
Bol.	„	„ H. Bolus, „

A

Phanerogamic Botany.

1 **Aiton,** *William,* b. 1731, d. 1793. *Hortus Kewensis, or a Catalogue of the plants cultivated in the royal botanic garden at Kew, London. 1789, 3 vols., 8vo.—I. xxx, 496 pp.—II. 460 pp.—III. 547 pp., 13 plates.—2nd ed.: enlarged by William Townsend Aiton. 1810—13. 5 vols. 8vo.

The 2nd ed. was edited from the commencement to the end of the class Dodecandria by Jonas Dryander; and from thence to Cryptogamia by Robert Brown.—Describes many of the earlier known Cape plants. (Sells 10*s*.—15*s*.) Libr. S. Afr.

2 **Andrews,** *Henry C.* *Botanists' Repository, comprising coloured engravings of new and rare plants only with botanical descriptions in Latin and English, after the Linnean system. London (1799—1811) 10 vols. 4to., 664 col. pl. with corresponding text.—Recensio plantarum hucusque in Repositorio botanicorum depictarum. A review of the plants hitherto figured in the Botanists' Repository. With a translation of the essential and specific characters. Index duplex. London, 1801, 4to. 74 pp., ind.

Contains figures of many Cape plants. (Sells £10—£15.)
Libr. Bol.

3 —— *Coloured engravings of Heaths. The drawings taken from living plants; with the appropriate specific character, full description, native place of growth, and time of flowering of each; in Latin and English, etc. London, 1802—30. 4 vols. folio, 288 col. pl., with corresponding text.

Fine plates, almost all of Cape heaths. The work is now somewhat rare. Libr. S. Afr. (the first 3 vols. only; some plates missing).

4 **Andrews,** *Henry C.* *The Heathery; or a monograph of the genus *Erica*, containing coloured engravings with Latin and English descriptions, dissections, &c. of all the known species of that extensive and distinguished tribe of plants. London, 1804—12. 6 vols. 8vo., 300 col. pl. with corresponding text, and indexes.

The plates are good, not identical with, though similar to, those in the preceding work. It is valuable to the student because the figures are largely cited by Bentham in his monograph of the Ericeae in De Cand. Prodromus, vol. VII. (Publ. £13. 10*s*., sells about £6.)
Libr. P.E., Bol.

5 —— *Geraniums, or a monograph of the genus *Geranium*, containing coloured figures of all the known species and numerous beautiful varieties, drawn, engraved, described and coloured from the living plants. London, 1805. 2 vols. 4to. 124 col. pl., text and index.

Contains many figures of Cape Pelargoniums, which include, however, many garden hybrids.
—— Somewhat rare (publ. £9. 9*s*.).

6 **Anderson,** *Thomas,* formerly Direct. Bot. Gard. Calcutta. *Enumeration of the species of Acanthaceae from Africa. In Journal of Linnean Society, vol. VII. London, 1864. pp. 13—54.

A more recent revision of the order than that contained in De Cand. Prodr. vol. XI., with many additions chiefly from Natal and Tropical Africa.
Libr. MacOw., Bol.

7 —— *On a presumed case of Parthenogenesis in a species of *Aberia* (*A. Caffra*, Hook f.). In Journ. Linn. Soc., vol. VII. London, 1864. pp. 67—68.
Libr. Bol.

8 **Antommarchi,** *Francesco,* Physician to Napoleon I. at St Helena, d. 1838. Derniers moments de Napoleon. Paris, 1825. 2 vols. 8vo., 5 pl. fol.

The second vol. contains: Esquisse de la Flore de St Hélène pp. 255—425. The plants include those in culture and are arranged according to the natural system. (Publ. 26 fr.)

9 **Armitage,** *Edward.* Lecture on the Botany of Natal. Pietermaritzburg, 1854. 8vo.

10 **Arduino,** *Luigi,* b. 1759, d. 1834. *Istruzione sull' olco di Cafreria. Ed. 2, riformata ed accresciuta. Padova, 1811. 8vo., 47 p. 1 tab.

An early account of the cultivation of the well-known "Sorghum."
Libr. MacOw.

11 **Arnott,** *George Arnold Walker,* b. 1799, d. 1868. *Notes on some South African Plants. In Hooker's Journal of Botany. London, 1841. 8vo. Vol. III., pp. 147—156 & 251—271.

Contains valuable remarks on the Terebinthaceae, Rhamneae, Celastrineae, and Bruniaceae of Drège's distributed exsiccata, with some strictures upon the rivalry and want of agreement between those who severally undertook the distribution of this celebrated collection, and of that of Ecklon and Zeyher.—Compare on this subject Walper's Animadv. Criticae in Linnaea, vol. XIII., p. 451.
Libr. MacOw., Bol.

Cryptogamic Botany.

12 **Afzelius,** *Adam,* Professor at Upsala, b. 1750, d. 1837. eliquiae Afzelianae sistentes Icones Fungorum ab Afzelio in Guineâ collec- rum, interpret. Friesio. Upsal, 1860. Fol. cum XII. tab. aen.

Contains figures of some Fungi whose area of distribution reaches the Cape.

13 **Agardh,** *Jakob Georg,* Prof. of Botany at Lund, b. 1813. †Iridaceae Generis Species Capenses. [Holmiae, 1847] 8vo. pp. 82—97. col. plates.

Reprinted from the Transactions of the Kongl. Vetenskaps Academien of Stockholm for 1847. Contains descriptions and plates of several Cape Algae. Libr. P. E.

14 —— *Revision der Algen-Gattung *Macrocystis.* In Nov. Act. Acad. Caes. Leop.-Car. Cur., vol. XIX. Vratisl. et Bonn, 1839. 4to., pp. 281—316. Taf. 26—28.

This memoir contains the first description and coloured figure of the Great Sea-Tangle of the Southern Ocean.
Libr. MacOw.

15 **Angstrom,** *Johan,* Verzeichniss und Beschreibung der Moose welche Prof. N. J. Andersson auf der Expedition der Fregatte Eugenies im Jahre 1871—1873 gesammelt hat. (Öfversigt af Kongl. Vetensk. Akad. Förhandl. Stockh., 1872-3.)

16 —— Musci et Hepaticae a N. J. Anderssonio coll. in America merid. Insulis Galapagos Tahiti et Sanct. Helena. (2 pt.) Holmiae, 1873. 8vo.

17 **Areschoug,** *J. E.,* Professor of Botany at Upsala, b. 1811. *Phyceae Capenses. Upsaliae, 1851. 4to. 4 Tab.

A series of dissertations ostensibly written by various candidates for the degree of Doctor of Philosophy under the presidency of Areschoug.
Libr. MacOw. (From pp. 1—32, without plates.)

B

Phanerogamic Botany.

18 **Baillon,** *Henri Ernest,* b. 1827. Histoire des Plantes. 6 voll. Paris, 1867—78. 8vo. avec plus de 1900 fig.

We do not know this work, and quote from a catalogue of Friedländer's, where it is offered for £6 10*s.*

The following monographs of interest to the Cape Student reprinted from the foregoing are published separately:—

19 —— Monogr. des Proteacées. 1870. av. fig. 2*s.* 6*d.*

20 —— †Monogr. des Geraniacées, Polygalacées, &c. 1873. 142 fig. 6*s.*

21 —— †Monogr. des Ochnacées et Rutacées. 1873. 152 fig. 7*s.*

22 Baillon, *Henri Ernest.* †Monogr. des Terebinthacées et Sapindacées. 1874. 168 fig. 7*s.*

23 —— †Monogr. des Celastracées et Rhamnacées. 1875. 57 fig. 4*s.* 6*d.*

24 —— †Monogr. des Penaeacées et Thymelaeacées. 1875. 57 fig. 7*s.*

25 Baker, *John Gilbert,* Assistant Curator Royal Herb. Kew. *Revision of the Genera and Species of Herbaceous Capsular Gamophyllous Liliaceae (Aloineae excepted). In Journal of the Linnean Society, vol. XI. London, 1870. 8vo. pp. 349—436.

The first of a series of valuable revisions of this vast order. For additions to above compare author in Trimen's Journal of Botany, Dec. 1874; and Gardeners' Chronicle, June 26 & Sept. 11, 1875.
Libr. MacOw., Bol.

26 —— *Nomenclature and Arrangement of the Cape species of *Anthericum.* In Trim. Journ. Bot., vol. I. N.S. London, 1872. pp. 99—101, 135—141.

In a subsequent revision (Art. 36) the arrangement is slightly altered.
Libr. S. Afr., MacOw., Bol.

27 —— *A new *Asplenium* from the Cape Colony. In Trim. Journ. Bot., vol. I. N.S. Lond. 1872. pp. 362—363.

Contains recognition of Pappe and Rawson's "Asplenium Ruta-Muraria" (in Syn. Fil. Austr. Afr. p. 20) as a new species.—*A. Rawsoni*, Baker.
Libr. MacOw.

28 —— *†Revision of the Genera and Species of Scilleae and Chlorogaleae. In Journ. Linn. Soc., vol. XIII. London, 1873. 8vo. pp. 209—292.

Compare also Trim. Journ. Bot., vol. III. N.S. Lond. 1874.
Libr. MacOw., Bol.

29 —— *On *Schizobasis,* a new genus of Liliaceae from Cape Colony. In Trim. Journ. Bot., vol. II. N.S. London, 1873. p. 105.
Libr. MacOw.

30 —— *On two new species of *Pellaea,* from Namaqualand. In Trim. Journ. Bot., vol. III. N.S. London, 1874. p. 199.
Libr. MacOw.

31 —— *On new and little known Capsular Gamophyllous Liliaceae. In Trim. Journ. Bot., vol. III. N.S. Lond. 1874. pp. 3—8.

Contains 6 Cape species.
Libr. MacOw.

32 —— *On the Genus *Androcymbium,* with descriptions of seven new species. In Trim. Journ. Bot., vol. III. N.S. Lond. 1874. pp. 243—246.
Libr. MacOw.

33 —— *Description of new species of Scilleae and other Liliaceae. In Trim. Journ. Bot., vol. III. N.S. Lond. 1874. pp. 363—368.

Contains 13 Cape species.
Libr. MacOw.

34 Baker, *John Gilbert.* *Revision of the Genera and Species of Asparagaceae. In Journ. Linn. Soc., vol. XVI. London, 1875. 8vo. pp. 508—632 with 4 plates (XVII.—XX.).

Libr. MacOw., Bol.

35 —— *Synopsis of the African species of *Xerophyta*. In Trim. Journ. Bot., vol. IV. N.S. Lond. 1875. pp. 231—236.

Contains several species from Natal, Free State, and Transkei.
Libr. MacOw.

36 —— *Revision of the Genera and Species of Anthericeae and Eriospermeae. In Journ. Linn. Soc., vol. XV. London, 1876. 8vo. pp. 254—363.

Libr. MacOw., Bol.

37 —— *On two new Amaryllidaceae from Natal. On the genus *Syringodea*, Hook fil. In Trim. Journ. Bot., vol. v. N.S. Lond. 1876. pp. 66—67.

Contains 5 Cape species.
Libr. MacOw., Bol.

38 —— *On new Bulbous Plants from the Eastern Provinces of the Cape Colony. In Trim. Journ. Bot., vol. v. N.S. Lond. 1876. pp. 181—184.

Contains eleven species, chiefly Transkeian.
Libr. MacOw.

39 —— *On new Species of *Ixiae*. In Trim. Journ. Bot., vol. v. N.S. Lond. 1876. pp. 236—239.

Contains 15 species.
Libr. MacOw.

40 —— *New *Aristeae* and *Sisyrinchia*. In Trim. Journ. Bot., vol. v. N.S. Lond. 1876. pp. 267—269.

Contains 3 Cape species.
Libr. MacOw.

41 —— *New *Gladioleae*. In Trim. Journ. Bot., vol. v. N.S. Lond. 1876. pp. 333—339.

Contains 27 African species.
Libr. MacOw.

42 —— *Systema Iridacearum. In Journ. Linn. Soc., vol. XVI. London, 1877. 8vo. pp. 61—180.

Invaluable as a universal index to the fragmentary and scattered literature of one of our most important Cape orders. It gives generic characters with analytical table, list of species, references to full descriptions, figures and a sufficient synonymy.
Libr. S. Afr., P.E., MacOw., Bol.

43 —— *On two new Genera of Amaryllidaceae from Cape Colony. In Trim. Journ. Bot., vol. VII. N.S. Lond. 1878. pp. 74—77.

Libr. S. Afr., MacOw., Bol.

44 Baker, *John Gilbert.* *A new Key to the Genera of Amaryllidaceae. In Trim. Journ. Bot., vol. VII. N.S. Lond. 1878. pp. 161—168.
Libr. S. Afr., MacOw., Bol.

45 —— *Descriptions of new and little known Liliaceae. In Trim. Journ. Bot., vol. VII. N.S. Lond. 1878. pp. 321—326.
Includes 5 Cape species.
Libr. S. Afr., MacOw., Bol.

46 —— *A Synopsis of Hypoxidaceae. In Journ. Linn. Soc., vol. XVII. London, 1878. pp. 93—126.
Libr. Bol.

47 —— *A classified list of the known species of *Apicra* and *Haworthia*. In Gardeners' Chronicle, vol. XI. N.S. (June 7), 1879. pp. 717—718.
A list preparatory to a systematic description of the tribe Aloineae.
Libr. S. Afr.

48 —— *A Synopsis of Colchicaceae and the Aberrant tribes of Liliaceae. In Journ. Linn. Soc., vol. XVII. London, 1879. 8vo. pp. 405—510.
These tribes include several Cape genera.
Libr. MacOw., Bol.

49 —— *A Synopsis of Aloineae and Yuccoideae. In Journ. Linn. Soc., vol. XVIII. London, 1880. pp. 148—241.
Libr. MacOw., Bol.

50 —— *Synopsis of the known species of *Crinum*. In Gardeners' Chronicle, vols. XV., XVI. London, 1881. 4to.
The portion of this memoir which concerns the Cape species is contained in vol. XVI. p. 760.

51 Barber, *Mary E.* *On the structure and fertilization of *Liparis Bowkeri*, Harv. In Journ. Linn. Soc., vol. X. London, 1869. 8vo. pp. 455—458, with fig.

52 —— *On the fertilization and dissemination of *Duvernoia adhatodoides*, E. Mey. In Journ. Linn. Soc., vol. XI. London, 1871. pp. 469—472, with fig.
Libr. Bol.

53 Bartling, *Friedrich Gottlieb*, Prof. Bot. Göttingen, b. 1798, d. 1875, and **Wendland,** *H. L.* *Beitraege zur Botanik. Goettingen. 1824—25. 2 vols. 8vo.—I.: Diosmeae descriptae et illustratae. 1824*x*, 214 p., 2 plates.—II.: 1825, 210 p.
The first part treats entirely of Diosmeae, and the 2 plates contain analytical figures of 9 species. The second part describes 17 Cape plants in section 1, entitled: "Descriptiones plantarum novarum vel minus cognitarum auctore Wendland." The most important of these belong to Capparideae and Ochnaceae. (Publ. 1½ Th.)
Libr. MacOw.

54 —— *Plantae Ecklonianae, Droseraceae, Laurineae, Myrtaceae, Celastrineae, Frankeniaceae, Resedaceae, Lineae, Violarieae, Menispermaceae, Portulaceae, Aloineae, Sileneae, Paronychieae, Scleranthеae, Ericeae. In Linnaea, vol. VII. Berlin, 1832. 8vo. pp. 538—541, 620—652.
Libr. S. Afr., MacOw., Bol.

55 Bartling, *Friedrich Gottlieb.* *Descriptiones Diosmearum Capensium novarum vel nondum ritè cognitarum. In Linnaea, vol. XVII. Halle, 1843. 8vo. pp. 353—382. Tab. 1 (x.)

Libr. MacOw., Bol.

56 Bauer, *Franz,* b. 1758, d. 1840. Delineations of exotick plants cultivated in the royal garden at Kew. Drawn and coloured and the botanical characters displayed according to the Linnean system. London, 1796 (1791—1800). No. 1—3. 30 col. plates (Ericae), pref.

57 —— Triginta tabulae *Ericarum* ineditae a Mackenzie sculptae. Londini, 1790—1800. fol.

58 —— **Strelitzia* depicta, or coloured figures of the known species of the genus *Strelitzia* from the drawings in the Banksian Library. London, 1818. 4 col. plates, numbered 1, 2, 3, 5, without text. "The work to be completed in four numbers, containing in the whole 16 highly finished coloured plates; the price two guineas and a half each number."

Compare **Ker,** *J. B.*, Art. 250.
Libr. MacOw.

59 —— *Illustrations of Orchidaceous plants with notes and prefatory remarks by Jas. Lindley. London, 1830—38. 4to. Pref. (2 p.). Pref. remarks (i.—xiv.). Plates I.—XV. (Fructification) with as many leaves of text. Plates I.—XX. (Genera) with as many leaves of text.

The drawings are very fine, and amongst the species figured are *Bonatea speciosa*, *Disa spatulata*, *Corycium bicolor*, *Ceratandra chloroleuca*, with analytical drawings on a large scale.

60 Beatson, *Alexander.* *Tracts relative to the Island of St Helena. London, 1816. 4to. With an Appendix:—An alphabetical list of plants seen by Dr Roxburgh growing on the island of St Helena in 1812—14. pp. 293—326.

A few copies of the alphabetical list were separately printed. (See also **Antommarchi,** Art. 8.)
Libr. S. Afr.

61 Bentham, *George.* *[The Tribe Ericeae.] In De Candolle's Prodromus Syst. Nat. Regn. Veg., vol. VII. 1839. pp. 612—711.

In the above reference we make an exception to the rule of not quoting separately the authors of the Prodromus, on account of the specially South African character of the Tribe.

62 —— *Labiatarum Genera et Species; or, a description of the genera and species of plants of the order Labiatae; with their general history, characters, affinities and geographical distribution. London, 1832—36. 8vo. lxviii., 1—783 pp. with map.

(Publ. 36*s.*, sells about 25*s.*)

63 —— *Synopsis of the Gerardieae. In Companion to the Bot. Mag., vol. I. London, 1835—36. 8vo. pp. 198—212.

64 —— *Synopsis of the Buchnereae. In Comp. to the Bot. Mag., vol. I. London, 1835—36. 8vo. pp. 356—384. With plate.

These papers contain valuable comments on the Cape species.
Libr. S. Afr.

65 Bentham, *George.* *Enumeration of Leguminosae, indigenous to Southern Asia and Central and Southern Africa. In Hooker's Lond. Journ. of Bot., vol. II. Lond. 1843. 8vo. pp. 423—481, 559—612. Vol. III. *ib.* 1844. pp. 338—365. Vol. VII. *ib.* 1848. pp. 580—657.

Describes many Cape species. On pages 426—428 of vol. II. is a careful review of the controversy as to priority of publication between Meyer's Commentaries and Ecklon and Zeyher's Enumeratio.
Libr. S. Afr., Bol.

66 —— *Notes on the Classification, History, and Geographical Distribution of Compositae. In Journal of the Linnean Society, vol. XIII. London, 1873. 8vo. pp. 335—557.

Contains a note of considerable significance on the Cape Compositae.
Libr. MacOw., Bol.

67 Bentham, *George* and Sir *J. D.* **Hooker.** *Genera Plantarum ad exemplaria imprimis in herbariis Kewensibus servata definita. Londoni, Vol. I. 1862—67.—Vol. II. 1873—76. Vol. III. pars 1ma, 1880.

This work, the *magnum opus* of the celebrated authors, is not yet completed. Indispensable to the Cape as to all botanical students.
Libr. S. Afr., MacOw., Bol.

68 Bergius, *Petrus Jonas*, b. 1730, d. 1790. *Descriptiones Plantarum e Capite Bonae Spei. Holmiae, 1767. 8vo. 360 pp., praef., ind., cum tab. aen. 5.

This is one of the post-Linnaean works treating exclusively of Cape plants, and is even now very useful in identifying the figures of the older school. The plates are excellent. Respecting the origin of the collection from which Bergius described, Thunberg says: "Mich. Grubb, Suecus e China redux, promontorium bonae spei vidit, eam collectionem plantarum numeratâ pecuniâ, ab Auge sibi acquisivit quam in hoc libro de plantis Capensibus elegantissime descripsit Illustr. Bergius." Flora Capensis, ed. Schultes, p. vii. [Respecting Auge above-named, see Lichtenstein, Travels, English Ed. II. p. 153.] (Sells at about 6*s.*)
Libr. S. Afr., MacOw., Fairbr., Bol.

Bergius, *C. W.* (Vide **Schlechtendal,** *D. F. L.*, art. 416.)

69 Bernhardi, *J. J.*, Professor at Erfurt, b. 1774, d. 1850. *Ueber die Gattung *Laurophyllus*, Thunb. oder *Botryceras*, Willd. In Linnaea, vol. XII. pp. 129—136.

Libr. MacOw., Bol.

70 Böckeler, *Otto.* *Die Cyperaceen des Koenigl. Herbariums zu Berlin. In Linnaea. 3rd Series, vol. I. Berlin, 1867. pp. 397—612.—Vol. II. 1869. pp. 271—512.—Vol. III. 1871. pp. 1—142, 520—647.—Vol. IV. 1874. pp. 223—544.—Vol. V. 1875. pp. 1—152.—Vol. VI. 1876. pp. 327—452.—Vol. VII. 1877. pp. 145—357.

These extended memoirs contain the latest revision of Cape Cyperaceae, with some new species.
Libr. Bol.

71 Boerhaave, *Herman*, Prof. Bot. Leyden, b. 1668, d. 1738. *Index alter plantarum quae in horto academico Lugduno Batavo aluntur. Lugd. Bat. 1720. 4to. I.:—34, 320 pp.—II.: 270 p., ind. et 40 tab. —— Ibid. 1727. 4to. (non differt).

Contains figures of Cape plants, chiefly Proteaceae.
Libr. MacOw.

72 Boissier, *Edouard.* *Icones Euphorbiarum ou Figures de 22 espèces du genre *Euphorbia* dessinées et gravées par Heyland, avec des considérations sur la classification et la distribution des plantes de ce genre. Paris, Bâle et Genève, 1856. Fol. 24 pp., 120 tab.

Contains figures of a few Cape *Euphorbiae.* (Pub. 70 fr., offered at 46*s.* to 56*s.*

73 Bolus, *Harry.* *Botany at the Cape. In Cape Monthly Magazine. Cape Town, 1869. 8vo. Vol. III. pp. 1—9.

Bolus, *Harry* and *P.* **MacOwan.** *Novitates Capenses.
(See MacOwan, Art. 322.)

74 Bowie, *James.* *Indigenous Plants, generally flowering in the months of October and November in the Cape district. [Extracted from a communication read in the South African Institution, 30th September, 1829. Printed by W. Bride Kirk, Cape Town.] 8vo. 12 pp.

A list of about 244 species, chiefly of interest from the notes referring to native names and uses of many of the plants.
Libr. Fairbr., Bol.

75 —— *Sketches of the Botany of South Africa. In the South African Quarterly Journal, vol. I. Cape Town, 1830. 8vo. pp. 27—36.

A list of 209 plants "generally flowering in the months of December, January, February and March in the Cape District" of slender value to the student.
Libr. Fairbr., Bol.

76 —— *On the Exotic Plants which have been introduced into South Africa. In the S. A. Quarterly Journal, vol. I. Cape Town, 1830. 8vo. pp. 160—171, 293—304, 408—413.

Papers chiefly on economical plants, with details of culture.
Libr. Fairbr., Bol.

77 —— *[On species of *Aloe* and *Gasteria.*] In the S. A. Quarterly Journal, vol. I. Cape Town, 1830. 8vo. pp. 90—91.

Describes 3 species of *Aloe* and 5 species of *Gasteria*, collected by the writer, with the localities of each.
Libr. Fairbr., Bol.

Besides the above it appears from the Proceedings of the S. A. Institution, as reported in the S. A. Q. Journal, vol. I. p. 83 that Bowie read the following papers, which were not printed in the Journal *in extenso*:—

Aug. 31, 1829. Remarks on the advantages of having a Botanic Garden near Cape Town (with a short abstract).

Same date. Sketches of the Botany of the Cape District, No. 1.

Sept. 30, 1829. Sketches of the Botany of South Africa, No. 2 (with a short abstract. This is the same as Art. 75 above, and appears to have been separately printed by the author).

78 Bradley, *Richard,* Professor of Bot. Cambridge, d. 1732. The History of Succulent Plants; containing the Aloes, Ficoids, Torch-Thistles, Melon-Thistles, &c., engraved from the originals. Historia Plantarum Succulentarum, &c. London, 1716—1727. 4to. Decades v. 70 pp., 50 plates. [Latin and English.]

A re-impression, with new title, appeared in 1734.

79 Bresler, *Moritz*, b. 1802, d. before 1851. *Generis *Asparagi* Historia Naturalis atque Medica Dissertatio. Auctor Mauritius Bresler. Berolini, 1826. 8vo. x. 46 pp.

Describes 83 species of Asparagus, the majority being from the Cape.
Libr. MacOw.

80 Breyn, *Jacob B.*, Merchant of Dantzic, b. 1637, d. 169[illegible]. *Jacobi Breynii Gedanensis Exoticarum aliarumque minus cognitarum Plantarum centuria prima, cum figuris aeneis summo studio elaboratis. Gedani, 1678. fol. min. i.—xxxiv., 1—195 pp. cum tab. 109. Index, Appendix (vide ten Rhyne).

The copy in the S. A. Public Library is inscribed "Joannes Commelinus e dono clarissimi auctoris;" it belonged to the late Dr Pappe, Colonial Botanist, and several MS. names subjoined to the plates are in his handwriting. (Price at 10s.) For the modern nomenclature of Breyn's plants see Art. 255, Klinsmann.
Libr. S. Afr., MacOw., Bol.

81 —— *Prodromi fasciculi rariorum plantarum primus et secundus, quondam separatim nunc nova hac editione multum desiderata conjunctim editi, notulisque illustrati. Accedunt icones rariorum et exoticarum plantarum aeri incisae, fasciculo olim promisso destinatae. Quibus praemittuntur vita et effigies auctoris, cura et studio, Johannes Philippi Breynii, *filii*, &c. Gedani, 1739. 4to. pp. 108, 54. Tab. 32.

The original editions of the first and second fasciculi were published in 1680 and 1689 respectively. Quoted by Thunberg (Flora Capensis) as treating of Cape plants. (Offered at 21s.) For modern nomenclature of the species see Art. 255, Klinsmann.
Libr. MacOw.

82 Brongniart, *Adolphe*, b. 1801. *Mémoire sur la Famille des Bruniacées. Paris, 1826. 4to. p. 357, cum tab. n. 35—38.
Libr. MacOw.

83 —— *Mémoire sur la Famille des Rhamnées. Paris, 1826. 4to. pp. I.—VIII., 9—78, pl. 1—6.

Contains analytical figures of 5 Cape species. These drawings are remarkably accurate and beautiful. (Pub. 4 fr. 50 c.)
Libr. MacOw.

84 Brown, *John Croumbie*. *Reports of the Colonial Botanist for the years 1863, 1864, 1865, 1866. Cape Town, 1864, 1865, 1866, 1867. Fol.

The Report for 1866 contains a list of Cape trees, shrubs and fruits, in the vernacular names, with a tolerably complete identification of their botanical equivalents. It is much to be desired that this list should be verified and extended by competent observers residing in the forest districts. It is already by far the fullest printed list existing.
Libr. S. Afr., MacOw. (1866), Bol. (1865).

85 Brown, *Nicholas Edward*, Assistant Curator Herb. Kew. *Notices of New Plants, especially *Stapeliae*. In Gardeners' Chronicle. London, Feb. 3, Mar. 17, Apr. 7, May 5, June 2, 1877. Small fol.]

86 —— *†The *Stapeliae* of Thunberg's Herbarium, with descriptions of four new Genera of Stapelieae. In Journal of the Linnean Society, vol. XVII. London, 1878. pp. 162—172. 2 plates (XI., XII.).
Libr. Bol., MacOw.

87 Brown, *Nicholas Edward.* *[On *Quaqua*, a new genus of Asclepiadeae.] In Gardeners' Chronicle, vol. XII. N.S., No. 288. July 3, 1879. pp. 8—9.

Describes *Quaqua Hottentotorum*, N. E. Brown. A new Stapelioid plant from Colonial Namaqualand, with excellent figures.

88 Brown, *Robert*, b. 1773, d. 1858. *On the Proteaceae of Jussieu. By Mr Robert Brown, Librarian of the Linnean Society. Read Jan. 17, 1809. In Linnean Society's Transactions, vol. x. London, 1810. 4to. pp. 15—226, with 2 plates.

The first thoroughly philosophical treatise upon this order so characteristic of the South African Flora. (Sells 9*s*.)
Libr. S. Afr., Bol.

89 —— *Description of the Female Flower and Fruit of *Rafflesia Arnoldi*, and the structure of *Hydnora africana*. London, 1844. 4to., with 9 plates. Reprinted from the Transactions of the Linnean Society, vol. XIX. pp. 221—247.
Libr. MacOw., Bol.

90 Bruinsma, *A. F. A.* De *Diosma crenata*. Dissertatio. Lugd. Batavorum, 1838. 4to.

91 Buchenau, *Franz*, M.D., b. 1831. *†Monographie der Juncaceen vom Cap, bearbeitet von Franz Buchenau. In Abhandlungen des Naturwissenschaftlichen Vereines zu Bremen. Band IV. Heft 4. Bremen, 1875. 8vo. pp. 393—512. Tab. V.—XI.

The plates are excellent. Compare a brief note by P. MacOwan on *Juncus effusus*, *L.* as a Cape plant, in Cape Monthly Magazine. Cape Town, Aug. 1877.
Libr. MacOw., Bol.

92 Buek, *H. W.*, M D., b. 1796. **Echia* Capensia disposuit H. W. Buek, Med. Dr. Hamburgensis. In Linnaea, vol. XI. Halle a. d. S. 1837. 8vo. pp. 129—149.

Refers to Ecklon's collected species of *Lobostemon* and may be usefully compared with Lehmann's Monograph, "Plantae e familia Asperifoliarum nuciferae." It is much to be regretted that the author did not quote the numbers of the plants of Drège and Zeyher, with which he worked.
Libr. S. Afr., MacOw., Bol.

93 —— *Genera, Species et Synonyma Candolleana, alphabetico ordine disposita, seu Index generalis et specialis ad A. P. De Candolle Prodromum Systematis Nat. Regn. Vegetabilis. Partes IV. Berolini et Hamburgi, 1840—1874. 8vo.

Part I. Berol. 1842. pp. i.—ix., 1—424 is the index to vols. I.—IV. of the Prodromus. Part II. Berol. 1840. pp. I.—VIII., 1—223, to vols. V., VI., and Sect. 1 of vol. VII., thus comprising the whole of the order Compositae. Part III. Hamb. 1858, including vol. VII. section 2, and vols, VIII.—XIII. Part IV. Hamb. 1874, completing the work. (Pub. 50 fr.)
Libr. MacOw. (parts I. and II.).

94 Bunbury, Sir *C. J. F.* *†Journal of a Residence at the Cape of Good Hope, with excursions into the interior, and notes on the Natural History and the Native Tribes. London, 1848. 8vo. i.—xii., 1—297 pp., 5 plates.

Contains some good descriptions of the aspects of vegetation in different parts of the Colony. (Sells about 5*s*.)
Libr. S. Afr., Bol.

95 Burchell, *William J.* *Travels in the interior of Southern Africa, by William J. Burchell, Esq., with an entirely new Map, and numerous Engravings. London, 1822. 2 vols. 4to.—Vol. I.: I.—XII., 1—582 pp., with 10 plates in aquatint, 50 woodcut vignettes, and map.—Vol. II.: I.—IV., 1—648 pp. with 10 plates in aquatint, and 46 woodcuts.

Burchell travelled in the Colony between 1810—1815. This work will always remain of sterling value to the geographer and naturalist from its extreme accuracy of observation and record. To botanists it is especially of value from its graphic description and figures of the vegetable landscape,—its copious notes of plants collected *en route*, and its descriptions of several new genera and species. (Pub. £9. 9*s*., sells for 30*s*. to 40*s*.)

Libr. S. Afr., P.E., Gr. Rt., MacOw., Fairbr., Bol.

96 —— *Catalogus Geographicus Plantarum Africae Australis Extratropicae. MS. 14 vols. 12mo.—In the Library of the Herbarium of the Royal Botanic Gardens, Kew.

This important manuscript contains the rotation-list of plants collected by Burchell during his South African travels. To each specimen was affixed a number corresponding to the entry of locality and date of collection given in the Catalogue. The numbers run from 1 to 8739; the dates from 5th Dec. 1810 to 1st Aug. 1815; and there are about 488 stations recorded, several of which are repeated. The Catalogue was intended for publication (see Travels, I. p. 18), but this design was never fulfilled. Only a small proportion of the entries have both the generic and specific names of the plants filled in; very many shew only the former; while in numerous instances the line following the rotation number is left blank. Hence the Catalogue in its present state is rather potentially than actually useful. Properly collated and completed from the determinations of the Kew set of the Plantae Burchellianae, it would form a valuable adjunct to Drège's Documente. It is, however, to be remarked that a considerable number of Burchell's plants have never yet been determined, and that not a few appear to be forms which have not been collected before or since his time. Owing to repetitions of numbers for the same species, and the loss of one parcel in transmission, the number of species collected falls considerably short of the last Catalogue number, and may possibly not exceed three thousand.—The following are given as specimens of the entries in the MS.:—

"On the right bank of the Ky-Gariep at the Zoutpans Drift, 28 and 29 October, 1811.

1752. Crotalaria virgultalis, *B*.

Along the rivulet on the upper side of Grahamstown (by Capt. Harding's). 27 August, 1813.

3529.

3530, &c. &c."

97 Burke, *Joseph.* *[Extracts from Journals of Travel in South Africa.] In Hooker's London Journal of Botany, vol. IV. pp. 643—653. Vol. V. pp. 14—22, 109—134, 313—344, 430—435. London, 1845—46. 8vo.

A very interesting account of the first botanical journey in the rich district of the Magaliesberg, Transvaal. Burke travelled as a botanical and zoological collector for the Earl of Derby in 1840—41, and was accompanied by Charles Zeyher of Uitenhage. The genus *Burkea* was dedicated to him by Sir W. J. Hooker. Compare **Zeyher**, Art. 551.

Libr. S. Af., MacOw., Bol.

98 Burman, *Jan*, Prof. Bot. Amsterdam, b. 1706, d. 1779. *Thesaurus Zeylanicus, exhibens plantas in Insula Zeylania nascentes inter quas plurimae novae species et genera inveniuntur, omnia iconibus illustrata ac descripta, cura et studiis Joh. Burmanni. Amstelaedami, 1737. 4to. 235 pp., ind., cum tab. aen. 110. Appendix: "Catalogi duo Plantarum

Africanarum quarum prior complectitur Plantas ab Hermanno observatas, posterior vero illas continet quas Oldenlandius et Hartogius indagarunt." p. 1—34. Item: "Plantae exoticae in Capite Bonae Spei aeque laete germinantes ac in earum patria."

Of little interest to Cape students excepting for the catalogues in the Appendix. The list of introduced plants is probably the oldest on record. (Sells 6*s.* to 8*s.*)
Libr. S. Afr., MacOw., Bol.

99 Burman, *Jan.* *Decades Plantarum Africanarum X ad vivum delineatarum iconibus ac descriptionibus illustratarum. Amstelaedami, 1738—39. 4to. i.—viii., 1—268 p., Index, Tab. I.—C.

There is a separate title-page to each Decade, and a fine portrait of the editor by Houbraken. Copies are frequently offered wanting the portrait; those with coloured plates are rare. (Priced by Friedländer: tab. nigr. 7 marks; tab. col. 30 marks.)
Libr. S. Afr., MacOw., Fairbr., Bol.

100 —— **Wachendorfia.* Amstelaedami, 1757. Folio. p. 4. tab. 1.

*Another impression appeared: Gera, 1771. 4to. xii. p. 3, tab. The plates are very fair representations of two Cape species.
Libr. Bol. (4to. ed.)

101 Burman, *Nicolaas Laurens.* Son of Jan, b. 1734, d. 1793. *Specimen Botanicum de *Geraniis.* Lugduni Batavorum, 1759. 4to. 52 p., 2 tab.

The earliest treatise on the genus. The plates represent 11 species. Some of the figures are quoted by De Candolle in the Prodromus. (Sells 3*s.* 6*d.*)
Libr. Bol.

102 —— *Flora Indica: cui accedit series Zoophytorum, nec non Prodromus Florae Capensis. Lugd. Bat. 1768. 4to. pp. 241, ind., 67 tab. praeter Prodr. Flor. Cap. 28 p.

The plates are exclusively Indian plants. The catalogue at the end is nothing more than Oldenland's collection printed in the Thesaurus Zeylanicus, but arranged according to the Linnean system. (Sells 10*s.* to 12*s.*)
Libr. MacOw., Bol.

Cryptogamic Botany.

103 Barkly, *Lady.* *†Revised List of the Ferns of South Africa, arranged according to the second edition of Hooker and Baker's Synopsis Filicum. Reprinted from the Cape Monthly Magazine, vol. x. N.S. pp. 193—207. Capetown, 1875. 8vo. pp. 15.

In this reprint Lady Barkly enumerates 153 species of South African Ferns; and in an autograph MS. note appended to a copy in Library Bol. indicates two additional new species. An excellent sketch of the Geographical Distribution of Cape Ferns follows the enumeration.
Libr. S. Afr., MacOw., Bol.

104 Berkeley, Rev. *Miles Joseph.* *On two Hymenomycetous Fungi belonging to the Lycoperdaceous group. In Hooker's London Journal of Botany, vol. II. London, 1843. 8vo. pp. 200—205, with 3 plates. (Tab. V., VI., VII.)
Libr. S. Afr., MacOw., Bol.

105 Berkeley, Rev. *Miles Joseph.* *Enumeration of Fungi collected by Herr Zeyher in Uitenhage. In Hook. Lond. Journ. Bot. vol. II. London, 1843. pp. 507—527, with plate. (Tab. XXII.)

Important contributions to Cape mycology containing notes of 33 species, of which 17 are here first described. Excellent figures of 8 species are given.
Libr. S. Afr., MacOw. (MS. transcript), Bol.

106 —— *Decades of Fungi. In London Journal of Botany, vol. III. London, 1844. 8vo. First Decade. pp. 185—194, with 2 plates. (Tab. V., VI.)

Contains notices of 5 Cape Fungi, 3 of which were previously undescribed, including the rare and curious *Broomeia*.
Libr. S. Afr., Bol.

107 —— *An Enumeration of the Fungi collected at the Cape of Good Hope during the stay of the English Transit of Venus Expedition in 1874. In Trimen's Journal of Botany, vol. v. N.S. London, 1876. 8vo. pp. 173—176.

Contains descriptions of 31 species, of which 6 are new.
Libr. MacOw.

108 —— *Two new Fungi. In Gardeners' Chronicle. London, 1876 (June 17). p. 785.

Gives figures of *Kalchbrennera Tuckii*, Berk. and *MacOwanites agaricina*, Kalchb., the latter under the name *MacOwania*, which is pre-occupied. See also Trimen's Journ. Bot., vol. v. N.S. 1876. pp. 248—249, where the substance of the article and the figures are taken over.
Libr. S. Afr., MacOw.

109 Bescherelle, *Emile.* Note sur les Mousses des Iles St. Paul et Amsterdam. In Comptes Rendus de l'Acad. des Sciences. Paris, 1876. 4to.

Describes 6 species from St. Paul, and 9 from Amsterdam Island.

110 Braun, *Alexander.* Professor of Bot. Berlin, b. 1805, d. 1877. Ueber *Marsilia* und *Pilularia*. In Proceedings of the Berlin Academy, 1863. 8vo.

An abstract, with synoptic list of species, is given in Seemann's Journal of Botany, vol. II. pp. 28—32. Contains 8 Cape species.

111 —— *Die Characeen Afrika's, zusammengestellt von A. Braun. Aus dem Monatsbericht der Königlichen Akademie der Wiss. vom Dec. 1867. Berlin, 1868. 8vo. pp. 782—872.

Contains extended descriptions of 15 Cape and Natal species, of which 6 are not found in other parts of the continent.
Libr. MacOw.

the Earl of
Zeyher. Uitenhage. The
Hooker. Compare Zeyher, A.
Libr. S. Af., MacOw., Bol.

endata *Marsiliarum* et *Pilulariarum*. In
II. N.S. London, 1873. pp. 55—61.

to the Cape, with brief analytical characters,
of 1868, Art. 110.

98 Burman, *Jan,* Prof. Bo
*Thesaurus Zeylanicus, exhibens pla
inter quas plurimae novae species et
illustrata ac descripta, cura et studiis J
4to. 235 pp., ind., cum tab. aen. 110.

l., b. 1761, d. 1828. *Bryologia
n disposito, historia et descriptio cm-
A cognitorum cum synonymia ex auct
edecim. Lipsiae, 1826—1827. 2 vols.

8vo.—Vol. I. 1826. pp. 1—746.—Vol. II. 1827. pp. i.—xlvi., 1—772. Ind. pp. 773—848. Plates I.—X. Suppl. to vol. I. pp. 747—856. Plates I.—III.

Contains descriptions of some Cape Mosses collected by Menzies, Burchell and others. (Priced, 1877, 7 marks.)
Libr. Bol., MacOw.

114 Bruch, *Philipp.* Musci Kraussiani. In the Regensburg "Flora." 1846. pp. 132—134.

Known to us by the title only. In the same Journal is also a paper on Gueinzius' Natal mosses, quoted by C. Mueller (Synopsis), and also by Jaeger.

115 Buchanan, Rev. *John*, M.A. *†Revised List of the Ferns of Natal. Reprinted from the "Natal Colonist." Natal: P. Davis and Sons, Durban and Maritzburg, 1875. 12mo. p. 30.

An extremely careful and valuable performance, deserving of better typographical form and a wider circulation.
Libr. MacOw.

C

Phanerogamic Botany.

116 de Candolle, *Augustin Pyramus*, b. 1778, d. 1841. *Plantarum Historia Succulentarum. Histoire des Plantes Grasses avec leurs figures en couleurs, dessinées par P. J. Redouté. Paris (Garnery), 1799—1829. XXXI. fasciculi. Folio. 159 p., 185 tab. col.

This splendid work, containing many plates of Cape succulents, is almost always in an incomplete state. Fasciculi I.—XX., with 120 plates, and as many pages of text, with title, preface, and index, form the first volume. These were followed by fasc. XXI.—XXVIII., containing plates and text numbered from 131—159 (as far as *Mesembryanthemum viridiflorum*) but without title or index. Fasc. XXIX.—XXXI., comprising 18 plates, were published by Garnery of Paris in 1828—29, with the assistance of the botanist A. Guillemin; but Pritzel remarks that these can scarcely be said to have been published, since they are not even found in the author's library, and are extremely rare. —— There are two impressions of this work; one in folio (of which plates 139—142 are often wanting, or supplied from the smaller edition) published at 930 fr.; and an edition in quarto published at 372 fr. —— (Copies of the folio ed. with 168 plates, as complete as the work is usually found, are offered at £5 to £6.)
Libr. S. Afr. (fol. 168 pl., 4to. 167 pl.), Bol. (fol. 169 pl. and fol. 144 pl., including 9 of the 18 rare pl.).

117 —— Note sur les genres *Diasia* et *Montbretia*. In Bull. Soc. Phil. 1803. p. 251.

118 —— Note sur le feuillage des *Cliffortia*. In Ann. des Sciences Nat., vol. I. Paris, 1824. p. 447.

119 —— Mémoire sur le *Vieusseuxia*. In Ann. Mus. d'Hist. Nat. II. pp. 136—141.

de Candolle, *A. P.*, et *P. J.* **Redouté.** See Art. 393.

120 de Candolle, *A. P.*, et *Alphonse* **de Candolle.** *Prodromus Systematis Naturalis Regni Vegetabilis sive Enumeratio Contracta Ordinum Generum Specierumque hucusque cognitarum, juxta Methodi Naturalis normas digesta. Parisiis, 1824—1874. 17 vols. (24 parts). 8vo.

The great Encyclopædia of phanerogamic exogenous botany, being thus far

an enumeration of all known plants. The contents of vols. I.—VII. are elaborated, so far as relates to Cape plants, in Harvey and Sonder's Flora Capensis; but the remaining volumes will remain indispensable in Cape botany until the publication of that work is completed. There is an Index of Genera to each vol.; a combined index to vols. I.—X. at the end of vol. X.; and a general one to the whole work closes vol. XVII. For Index of Species see **Buek**, Art. 93. (Publ. in paper 280 fr. Copies half-bound are offered at £12, or with Buek's Index, £15.)
Libr. S. Afr., P.E., MacOw., Bol.

121 de Candolle, *Alphonse Louis P. P.* Son of Aug. Pyr., b. 1806. Monographie des Campanulées. Paris, 1830. 4to. pp. viii., 384. 20 tab.

Contains many Cape species. (Pub. 25 fr.)

122 —— *Géographie botanique raisonnée ou exposition des faits principaux et des lois concernant la distribution géographique des plantes de l'époque actuelle. 2 tomes. Paris, 1855. 8vo. pp. xxxii., iv., 1366. 2 maps.

Treats, in part, of the distribution of Cape plants. (Pub. 20 fr.)
Libr. S. Afr.

123 —— *Espèces Nouvelles du Genre *Thesium* prés. à la Soc. phys. et hist. nat. Genève le 28 mai, 1856. Genève 6 Juin, 1857.

Incorporated, with modifications, in the Prodromus Syst. Nat. Regn. Veg., vol. XIV. Confer Sonder Enum. Santal., Arts. 430—431, which appeared immediately after the above (21 June, 1857), and gave rise to a warm controversy.

124 de Candolle, *A. L. P. P.*, et **de Candolle,** *Casimir* (son of Alphonse). *Monographiae Phanerogamarum Prodromi nunc continuatio, nunc revisio, auct. A. et C. de Candolle, aliisque botanicis ultra memoratis.—Vol. I.: Smilaceae, Restiaceae, Meliaceae. Parisiis, Junio, 1878. 8vo. pp. i.—ii., 783, tab. 9.—Vol. II.: Araceae. Parisiis, Sept. 1879. 8vo. 681 pp.—Vol. III.: Philydraceae, Alismaceae, Butomaceae, Juncagineae, Commelinaceae, Cucurbitaceae. Paris, Junio, 1881. 8vo. 1009 pp., tab. 8.

The volumes of this important work hitherto published are chiefly valuable to the worker in Cape botany for the revision of the difficult order Restiaceae by Dr M. T. Masters, with several plates in vol. I., and for M. Cogniaux's monograph of the Cucurbitaceae in vol. III. (Publ. vol. I., 30 fr.; vol. II., 18 fr.; vol. III., 30 fr.)
Libr. MacOw., Bol.

125 Carmichael, *Dugald*, b. 1772, d. 1827. *[An account of the Botany of some portions of South Africa.] In Hooker's Botanical Miscellany, vol. II. London, 1831. 8vo. pp. 1—59, 259—289.

This is contained in a brief memoir of the writer, who was a Captain in the 72nd Regiment, and present at the taking of the Cape in 1806. He botanized near the Muizenberg Pass, and at Algoa Bay, at both of which places he was stationed for some time.
Libr. S. Afr.

126 Cavanilles, *Antonio José*, Prof. Bot. Madrid, b. 1745, d. 1804. *Icones et Descriptiones plantarum quae aut sponte in Hispania crescunt, aut in hortis hospitantur. Matriti, 1791—1801. 6 vols. folio. Tab. 600.

Contains several Cape plants. (720 fr. at Barcelona. Offered recently at £12.)

127 Cavanilles, *Antonio José.* *Monadelphiae classis dissertationes Decem. Matriti, ex typographia regia, 1790. 4to. x., 463 pp., 96 tab.

Contains many figures of Cape Malvaceae, Byttneriaceae and Geraniaceae.
Libr. MacOw. (Diss. I.—VI.).

128 Chamisso, *Adalbert von,* b. 1781, d. 1838, and *Diedrich* **Schlechtendal.** *De Plantis in Expeditione Speculatoria Romanzoffiana observatis rationem dicunt A. de Chamisso et D. de Schlechtendal. In Linnaea, vol. I.—X. Berol. 1826—36. 8vo.

Adelbert von Chamisso, the well-known author of "The Shadowless Man," joined the Russian exploring expedition fitted out in 1815 by Count Romanzoff, and botanized at the Cape of Good Hope during the detention of the "Rurick" in Table Bay. This was only from March 31 till April 8, 1818, but the number of plants collected by him and his colleague Eschscholz is very considerable. It is curious that no Heaths appear among the number. The collections were elaborated with the assistance of Dr Schlechtendal, then in charge of the Royal Herbarium at Berlin, and are arranged in their systematic order, not in geographical sections. Hence it is impossible to give separate references.
Libr. S. Afr., Bol., MacOw.

129 —— *Plantae Ecklonianae, Gentianeae, Rosaceae, et generis Euclease species duae. In Linnaea, vol. VI. Berol. 1831. 8vo. pp. 343—351.

Libr. S. Afr., MacOw., Bol.

130 —— *Plantae Ecklonianae. Gentianarum et Rosacearum novarum descriptiones fusiores addit A. de Chamisso. In Linnaea, vol. VIII. Berol. 1833. 8vo. pp. 52—56.

Treats of four species only.
Libr. S. Afr., MacOw., Bol.

131 Chapman, *James.* Travels in the Interior of South Africa. 2 vols. London, 1858. 8vo. With a botanical appendix by John Sanderson and Rev. Edward Armitage.

Libr. S. Afr., P.E., Gr. Rt.

132 Choisy, *Jacques Denys,* Prof. at Geneva, b. 1799, d. 1859. Mémoire sur la famille des Selaginées. Genève, 1823. 4to. 44 pp., 5 tab.

Embodied in vol. XII. of de Candolle's Prodromus.

133 Commelin, *Jan,* Prof. Bot. Amsterdam, b. 1629, d. 1692. *Horti Medici Amstelodamensis rariorum, tum orientalis, quam occidentalis Indiae, aliarumque peregrinarum plantarum magno studio ac labore, sumtibus civitatis Amstelodamensis longa annorum serie collocatarum descriptio et icones ad vivum aeri incisae. Opus posthumum. Latinitate donatum, notisque et observationibus illustratum a Frederico Ruyschio et Francisco Kiggelario. Amstelodami, apud P. et J. Baen, 1697—1701. 2 vol. folio.—Pars prima: 1697. 220 pp., 112 tab.—Pars altera, auctore Caspare Commelino: 1701. 224 pp., ind., 112 tab. (Latin and Dutch.)

Contains figures of many Cape plants characterised by Linnaeus as "figurae splendidae." The copy in the S. A. Public Library bears the autograph of the well-known Aylmer Bourke Lambert, author of a magnificent work upon the genus Pinus, and most of the plates bear the Linnean names, apparently in his handwriting.
Libr. S. Afr., MacOw., Bol.

134 Commelin, *Kasper*, Prof. Bot. Amst., b. 1667, d. 1731. *Horti Medici Amstelaedamensis plantae rariores et exoticae ad vivum aeri incisae. Lugduni Batavorum, 1706. 4to. Praef., 48 pp., 48 tab. (Another edition dated 1715 does not differ.)

Contains figures of many Cape plants.
Libr. S. Afr., MacOw., Bol.

135 —— *Praeludia botanica ad publicas plantarum exoticarum demonstrationes; his accedunt plantarum rariorum, in Praeludiis botanicis recensitarum, icones et descriptiones. Lugduni Batavorum, 1703. 4to. 85 pp., 33 tab. Idem. Lugd. Bat. 1715. 4to. 85 pp., 33 tab.

Contains several plates of Cape plants.
Libr. S. Afr., MacOw. (first impression).

136 Cruse, *Wilhelm*, Prof. at Königsberg, b. 1803. *De Rubiaceis Capensibus praecipue de genere *Anthospermo*. Dissertatio Inauguralis. Berolini, 1825. 4to. pp. 24, tab. 2.

Libr. S. Afr., MacOw., Fairbr., Bol.

137 —— *De Anthospermeis, Rubiacearum sectione. In Linnaea. Berol. 1831. 8vo. pp. 1—21.

A recension of the previous work with collation of Ecklon's collections. Compare Cham. and Schlect. de Rubiaceis. Linnaea III. 1828. p. 309.
Libr. S. Afr., MacOw.

138 —— Plantae Ecklonianae. Rubiaceae, auct. G. Cruse. In Linnaea, vol. VII. Berol. 1832. 8vo. pp. 132—135.

From the text of this opuscule it is evidently by the same author as the two previous memoirs; the change of initial is due to translation.
Libr. S. Afr., MacOw., Bol.

139 Curtis, *William*, Founder and Editor of Bot. Mag., b. 1746, d. 1799. *The Botanical Magazine, or flower-garden displayed; in which the most ornamental foreign plants, cultivated in the open ground, the greenhouse and the stove, will be accurately represented in their natural colours. To which will be added their names, class, order, generic and specific characters, according to the celebrated Linnaeus; their places of growth and times of flowering, together with the most approved methods of culture. A work intended for the use of such ladies, gentlemen and gardeners as wish to become scientifically acquainted with the plants they cultivate. London (various publishers). 1787—1881. 106 vols. large 8vo. 6533 col. plates and text.

Series I., vols. 1—53, being vols. 1—14 by W. Curtis; vols. 15—42 by J. Sims; vols. 43—53, or New Series vols. 1—11 by J. Sims, plates 1—2704, with text, 1786—1826, and index to the first 42 vols. 1817.

Series II., vols 54—70, or New Series vols. 1—17, plates 2705—4131, by S. Curtis and W. J. Hooker, with text, 1827—1844.

Series III., comprising the plants of the Royal Gardens of Kew and of other botanical establishments in Great Britain, with suitable descriptions, and a supplement of botanical and horticultural information, vols. 71—106, or Third Series vols. 1—36, plates 4132—6533, by W. J. and Joseph Dalton Hooker, with text, 1845—1881. (In progress.)

The earlier volumes of this magnificent series of coloured plates contain a vast number of Cape plants, which were then in high fashion among horticulturists. (The Third Series was published at 42*s.* per volume. Complete sets of the whole work, now somewhat scarce, fetch about £100.)
Libr. S. Afr., Bol.—(MacOw. I.—XL.).

Cryptogamic Botany.

140 Crombie, *James M.* *New Lichens from the Cape of ood Hope. In Trimen's Journal of Botany. London, 1876. 8vo. Vol. xiv. . 19—21.

Libr. MacOw.

141 —— *Lichenes Capenses: an enumeration of the Lichens llected at the Cape of Good Hope by the Rev. A. E. Eaton during the enus-Transit Expedition, 1874. In Journal of Linnean Society. London uly), 1876. 8vo. Vol. xv. pp. 165—180.

The author enumerates 97 species, of which 31 are described as new by Nylander.
Libr. MacOw., Bol.

142 Cooke, *Mordecai Cubitt.* *Exotic Fungi. In Grevillea, ol. ix., No. 49. London, 1880. 8vo. pp. 14—15.

Enumerates nine species from Natal.
Libr. MacOw.
See also **Kalchbrenner,** Arts. 268, 269.

D

Phanerogamic Botany.

143 Decaisne, *Joseph,* Prof. in Paris, b. 1809, d. 1882. Note sur trois espèces de *Hydnora*. In Bulletin de la Société Bot. de France. 1873. pp. 75—77.

Merely proposes subgeneric division of *Hydnora* according to the trimerous or tetramerous arrangement of the floral organs.

144 De la Roche, *Daniel,* b. 1743. *Descriptiones plantarum aliquot novarum Dissertatio. Lugd. Batavorum, 1766. 4to. 35 pp., 5 tab. col.

Quoted by Thunberg as containing Cape plants.
Libr. S. Afr. (plates uncoloured).

145 De la Roche, *François,* M.D. *Eryngiorum* nec non generis novi *Alepideae* historia. Parisiis, 1808. Folio. 70 pp., 32 tab.

Describes correctly and figures our *Alepidea ciliaris*, Lam., a curious Umbellifer which Bergius had taken for a *Jasione*. (Offered at 6 marks.)

De la Roche, *F.*, and *P. J.* **Redouté,** see Art. 393.

146 Delessert, *Benjamin,* b. 1773, d. 1847. *Icones selectae plantarum, quas in systemate universali ex herbariis Parisiensibus, praesertim ex Lessertiano descripsit Augustin Pyramus de Candolle ex archetypis specimine a P. J. F. Turpin [Riocreux, Heyland, Decaisne] delineatae. Paris. 1820—46. V. voll. folio.—I.: 1820, vi., 26 pp., 100 tab.—II.: 1823, iv., 28 pp., 100 tab.—III.: 1837, viii., 70 pp., 100 tab.—IV.: 1839, iii., 52 pp., 100 tab.—V.: 1846, iv., 55 pp., cum indice generali, 101 tab.

Contains figures of many Cape plants. (Pub. 175 fr. Priced, Friedländer, 1877, 135 marks.)
Libr. Bol.

Delile, *Alire Raffenau-*, and *P. J.* **Redouté,** see Art. 393.

147 **Dillenius,** *Johann Jakob,* Prof. Bot. Oxford, b. 1687, d. 1747. *Hortus Elthamensis, seu plantarum rariorum quas in horto suo Elthami in Cantio coluit vir ornatiss. Jacobus Sherard, delineationes et descriptiones, quarum historia vel plane non, vel imperfecte a rei herbariae scriptoribus tradita fuit. Londini, sumtibus auctoris, 1732. II. vol. folio., VIII, 437 pp., 324 tab.

Contains many Mesembryaceae and other Cape succulents; and (on p. 228) has an account of the introduction of the genus *Mesembryanthemum* into Europe. The plates are said to have been engraved on pewter. The work is generally bound in 2 vols. for convenience, but the pagination is consecutive, and there is no duplicate title-page for a second volume. In the first part a supplementary plate follows No. 167. (Priced at 15*s.* to 20*s.*) Compare (Art. 256) **Klinsmann,** Clavis Dilleniana.
Libr. MacOw., Bol.

148 **Don,** *David,* Prof. Bot. King's College, b. 1800, d. 1841. An attempt at a new arrangement of the Ericaceae. In the Edinburgh New Philosophical Journal, No. 33. April—July, 1834. p. 150.

Compare Klotsch's criticism of this able memoir in Linnaea, vol. IX. (1831), p. 67.

149 **Drège,** *Jean François.* *Zwei Pflanzengeographische Documente von J. F. Drège, nebst einer Einleitung von Dr E. Meyer, Prof. in Königsberg (Besondere Beigabe zur Flora, 1843. Band II.). No imprint or date. Printed as a supplement to the botanical journal "Flora." Regensburg, 1843. 8vo. 230 pp., with Map.

This forms the most valuable published record of phyto-geographical facts relating to the Cape. The author enumerates the stations at which he collected, during eight years, the enormous number of 7092 species of flowering plants. These stations he grouped according to a geographical arrangement more fully described in E. Meyer's Commentaries (Art. 333), pp. X.—XXIX. The altitude and the date are given approximately, and in the case of plants imperfectly determined, the rotation number upon their labels is frequently though not always given. The authors of the "Flora Capensis" might reasonably have been expected to have availed themselves of the valuable lists of stations given in this work and to have arranged them under their descriptions in systematic order; but this was not done. Compared with Burchell's collections and unpublished MS. (Art. 96) it may be said that while Drège's journeys were more extensive, his collections probably twice as rich in species, and his recorded observations even more full and equally accurate, his specimens in completeness, range, and preservation fall far below those of the earlier English traveller. (Sells 3 marks.)
Libr. S. Afr., MacOw., Bol.

150 —— Catalogus Plantarum exsiccatarum Africae australioris quas emturis offert. 8vo. No. 1 (20 Mart. 1837) 11 pp.—No. 2 (20 Mart. 1838) pp. 13—32.—No. 3 (24 Apr. 1840) 16 pp.

These are mere lists of the dried Cape plants offered for sale by Drège, but appended to the last part are Klotsch's determinations of the Ericeae in the collection, correcting errors in the nomenclature of specimens referred to in pp. 7—8 of Part 1.

Respecting Drège's plants, compare Linnaea, XIX. 583—680, XX. 183—258.
Libr. MacOw. (No. 2 only).

151 Drège, *Jean François.* *Standorter Verzeichniss der von L. Zeyher in Süd-Afrika gesammelten Pflanzen. 8vo. 16 pp. In Linnaea, vol. XIX. Halle, 1847. 8vo. pp. 583—598.

This list appears to have been compiled by Drège from information supplied by Zeyher, and connects the localities of Zeyher's collected plants with those of Drège in the works noticed in Arts. 149 and 150.
Libr. MacOw., Bol.

152 —— *Vergleichungen der von Ecklon und Zeyher und von Drège gesammelten suedafrikanischen Pflanzen mit den Exemplaren von Zeyher's neuesten Sammlungen, welche derselbe zum Verkauf stellt durch J. F. Drège in Borstel bei Hamburg. Dec. 1846. In Linnaea, vol. XIX. Halle, 1847. 8vo. pp. 599—680.—Vol. XX. Id. 1847. pp. 183—258.

Chiefly valuable as a record of localities.
Libr. MacOw., Bol.

153 Driessen, *J. G.* Scheikundig onderzoek van eene soort van Soda welke uit den *Fucus buccinalis*, in de nabijheid van de Kaap de Goede Hoop wordt bereid. [Amsterdam, 1823.] 4to. 20 pp.

No imprint or date. A reprint from Verhand. koninkl. nederlandsche Inst. Wetensch. VI. (1828) 233—250.
Libr. MacOw.

153a Durban, *W. S. M.* *On the Naturalized Weeds of British Kaffraria. In Journal of Linnean Soc., vol. VIII. London, 1865. 8vo. pp. 267—272.

Libr. Bol.

154 Dyer, *W. T. Thiselton,* Assist. Director Kew Gardens. *The Tree Aloes of South Africa. In *Nature*. London, 1874 (Dec. 3). pp. 89—91, with illustrations.

Compare *Gardeners' Chronicle*, May 2, 1874.
Libr. MacOw.

155 —— *Note on *Aloe Barberae*, Dyer. In Trimen's Journ. Bot., vol. IV. N.S. London, 1875. pp. 49—50.
Libr. MacOw.

156 —— *On the genus *Hoodia*, with Diagnosis of a New Species. In Journal of Linn. Soc., vol. XV. London, 1876. pp. 248—252, with plate (T. V.).

Contains an excellent woodcut of *Hoodia Gordoni* from a photograph by the traveller Chapman. The plate gives analysis of a new species, *H. Barkleyi*, and comparison with *Decabelone elegans*, Decne.
Libr. Bol.

Cryptogamic Botany.

157 Dickie, *George,* Prof. Bot. Aberdeen, d. 1882. *On the Marine Algae of the Island of St Helena. In Journal of the Linnean Society, vol. XIII. London, 1873. 8vo.

Contains elaboration of the Algae collected by J. C. Melliss. Only 18 species were found, of which half are common to the Cape shores, a proof of the astonishing poverty of the Helenian marine flora.
Libr. Bol.

158 Dickie, *George.* *Algae collected by H. N. Moseley at Simon's Bay, and at Seal Island in False Bay, Cape of Good Hope. In Journ. of Linnean Society, vol. xv. London, 1875. pp. 40—42.

Contains 5 species from the former, 8 from the latter locality.
Libr. Bol.

E

159 Ecklon, *Christian Friedrich,* b. 1795, d. Cape Town 18[illegible] *Topographisches Verzeichniss der Pflanzensammlung von Christian Friedr. Ecklon. Erste Lieferung; oder: Standorte und Blüthezeit derjenigen Art aus der Familie der Coronarien und Ensaten, welche bis jetzt auf den Vorg. birge der guten Hoffnung beobachtet und gesammelt worden sind von C. F. Ecklon. Esslingen, 1827. 8vo. I.—X., 44 pp., 1 Tabelle.

Published at the expense of the Wurtemburg Natural History Reise-Verein, well known as the "Unio Itineraria," under the management of Drs Hochstetter and Steudel. This club took over and distributed several of Ecklon's collections. Compare F. Buchenau, Monographie der Juncaceen vom Cap, &c. (Art. 91), pp. 508—509; also Hooker's London Journ. of Bot., vol. I. Lond. 1834. 8vo, pp. 171—174. The work contains a sketch-plan of a small botanical garden in Cape Town belonging to one Joubert, in which the beds, or plots, were systematically arranged. (Pub. ⅓ Th.)
Libr. MacOw., Bol.

160 —— *†A list of plants found in the district of Uitenhage between the months of July 1829 and February 1830. In the South African Quarterly Journal, vol. I., No. IV. Cape Town, 1830. 8vo. pp. 358—380.

Contains a brief sketch of the physical features of the district, and the list, in which, however, a large number of the plants are incompletely named. About 1640 species were collected, and of these eleven phanerogams are described as new. There are included in the list about seventy cryptogams.
Libr. Fairbr., Bol.

161 —— *Nachricht über die von Ecklon und Zeyher unternommenen Reisen und deren Ausbeute in botanischer Hinsicht. In Linnaea, vol. VIII. Berol. 1833. 8vo. pp. 390—400.

Contains a brief account of the extensive travels undertaken by these two diligent workers in the cause of science. A priced catalogue of bulbs and seeds taken to Europe for sale is appended.
Libr. S. Afr., MacOw., Bol.

162 Ecklon, *C. F.,* et *Karl* **Zeyher.** Enumeratio Plantarum Africae Australis Extratropicae, quae collectae determinatae et expositae sunt a Chr. Fr. Ecklon et Carolo Zeyher. Pars I. [—III.] Hamburgi, 1835—1837. 8vo. pp. 1—400.

An attempt on the part of Ecklon to elaborate his own collections in a descriptive catalogue, giving brief characters of the new species. Neither the author's means nor his leisure seem to have sufficed to carry out his intention satisfactorily. The synonymy is scanty and irregular, and there are innumerable evidences of haste, owing perhaps to the impending publication of Drège's plants by Dr E. Meyer. Walpers (Animadversiones Criticae, Art. 535) comments severely on the shortcomings of this opusculum; and his significant *meiosis*, "sileo diram illam Ecklonis cupidinem generum specierumque novorum construendorum," touches the weak part of the Enumeratio with a needle's

point. There does not appear to have been any title except that upon the wrapper, or any index and table of contents; a presumptive proof that the work was abandoned by the author, without completing his original design. Respecting the contested claim for priority between this work and Meyer's Commentaries, compare Walpers (above cited); Meisner, in Hooker's Lond. Journ. Bot., vol. II., 1843, p. 60; Bentham, ibid. pp. 426—428; and Schlechtendahl, in Linnaea, vol. XIV. p. 706.
Libr. S. Afr., MacOw., Bol.

163 Edwards, *Sydenham.* *The Botanical Register, consisting of coloured figures of exotic plants, cultivated in British gardens; with their history and mode of treatment. The designs by Sydenham Edwards. Vol. I.—XXXIII. London, 1815—47. 8vo. 2702 tab., as many pages of text and appendixes.

Vols. 1—23 comprise plates 1—2014; vols. 24—33 contain 688 plates, numbered for each volume. The second series, from vol. 14 (1828) onwards, was edited by John Lindley, who supplied the appendixes and, in 1839, a general index of the preceding vols.—Contains many Cape plants. (Offered at £30 to £35.)
Libr. Bol.

164 Ettingshausen, *C. von.* Ueber die Genetische Gliederung der Cap-Flora. Wien, 1875. 8vo.

We have not seen this. The author is a worker in fossil botany, and we believe the present work bears upon this subject.

F

Phanerogamic Botany.

165 Fenzl, *Eduard,* Curator Bot. Mus. Vienna, b. 1808, d. 1879. Monographie der Mollugineen und Steudelieen zweier Unterabtheilungen der Familie der Portulaceen. In Annalen der Wiener Museums der Naturgeschichte. Wien, 1836. I. pp. 337—384, tab. 1. II. 1839, pp. 308—310.

166 —— *Pemptas Stirpium novarum Capensium. In Linnaea, vol. XVII. Halle, 1843. 8vo. pp. 323—334.

Describes a few species of Cape plants.
Libr. MacOw., Bol.

167 Flueckiger, *F. A.,* and *Dan.* **Hanbury.** Pharmacographia. A history of the principal drugs of vegetable origin. London, 1874. Roy. 8vo. Ed. 2. 1879.

Contains (pp. 616—627) the fullest and most recent account of the drug, Cape Aloes; and (in pp. 98—101) of Buchu.
Libr. MacOw.

168 Focke, *W. O.* †Batographische Abhandlungen. Aus den Abhandl. des Naturwiss. Vereins zu Bremen. Band IV. pp. 139—204. Bremen, 1874. 8vo.

Six Cape species are described in pp. 171—177. Of these *Rubus Ecklonii,* Focke, is new.

Cryptogamic Botany.

169 Flotow, *Julius von,* b. 1788, d. 1856. *[Lichenes Capenses Kraussiani.] In Linnaea, vol. XVII. Halle, 1843. 8vo. pp. 20—30.

The names and localities of the species described are given in Krauss's Beitrage, pp. 199—200 (see Art. 261).
Libr. MacOw., Bol.

170 Fries, *Elias Magnus,* Prof. Bot. Upsal, b. 1794, d. 1878. *Fungi Natalenses quos annos 1839—40 collegit J. A. Wahlberg, adjectis quibusdam Capensibus, descripti ab E. Fries. (Holmiae) Kon. Vetensk. Handl. 1848. 8vo. pp. 122—154.

Contains 45 species of Hymenomycetes, of which five are Zeyher's.
Libr. MacOw., Bol.

G

Phanerogamic Botany.

Gawler, see **Ker.**

171 Giseke, *Paul Dietrich,* Prof. Hamburg, b. 1741, d. 1796. *Index Linnaeanus in Leonhardi Plukenetii opera botanica. Accessere variae in vitam et opera Plukenetii observationes partim ex ipsius manuscriptis. Index Linnaeanus in Joannis Jacobi Dillenii historiam muscorum. Hamburgi, 1779. Folio. x., 46 pp. Hamburgi, 1779. 4to. x., 39 pp.

A key to **Plukenet's** large work, see Art. 384.

172 Grey, *George,* M.D. Herb Poisoning at the Cape of Good Hope. In Pharmaceutical Journal and Transactions. London, 1874. p. 248.

A memoir on the Middleburg poisoning case in 1872, in which "Tulp" (? Moraea polyanthos, *Thunb.*) seems to have been administered. Contains remarks on other Cape poisonous plants, but nothing new. *Ornithogalum altissimum,* L. (*Urginea,* Baker) is erroneously set down as a strychnoid poison. Compare Pappe, Flor. Cap. Med. Prodr. pp. 37—39 and 41.

173 Grisebach, *Heinrich Rud. Aug.,* Prof. Bot. Göttingen, b. 1814, d. 1880. *Die Vegetation der Erde, nach ihrer klimatischen Anordnung. Ein Abriss der vergleichenden Geographie der Pflanzen. 2 vols. Leipzig, 1872. 8vo.—Vol. I. pp. i.—xii., 1—603.—Vol. II. pp. i.—x., 1—709. Mit einer Uebersichts-Karte der Vegetationsgebiete.

The second volume contains descriptions of the South African regions, "Kalihari" and the "Cape." With few original observations these form a complete resumé of what has been written on this subject, and are of great value to the student of Cape phyto-geography. The work has been translated into French, with annotations, by the well-known botanist M. P. Tchihatchef, "La Végétation du Globe, d'après sa disposition suivant les Climats." Paris, 1877. 8vo. Vols. I.—III. (Priced 21*s.*)
Libr. Bol.,—MacOw. (French translation).

Cryptogamic Botany.

174 Geheeb, *Adelbert.* *Mousses nouvelles de l'Afrique Méridionale. In Revue Bryologique. No. 5. Paris, 1878. 8vo. pp. 69—72.

Contains a notice of Dr A. Rehman's Cape muscological collections made in 1875—77. There follows a list of 130 species, but without diagnoses. They are, however, by no means all which are contained in Rehman's exsiccata awaiting publication. In Herb. MacOwan are about sixty more, the greater part of which are already named by the learned collector himself, and by Dr C. Mueller.
Libr. MacOw.

175 Gerrard, *W. J.*, and *M. J.* **MacKen.** Synopsis Filicum Capensium. Pietermaritzburg, 1870. 8vo.

176 Gottsche, *Karl Moritz*, b. 1808. *Synopsis Hepaticarum. Conjunctis studiis scripserunt et edi curaverunt C. M. Gottsche, J. B. W. Lindenberg et C. G. Nees von Esenbeck. Hamburgi, 1844—47. 8vo. xxii., 834 pp.

This work is indispensable to the study of Cape Hepaticology. It absorbs all previous work on the subject up to the date of publication, since which very little has been done. (Publ. 5 Th., sells 12*s*.)
Libr. MacOw.

H

Phanerogamic Botany.

177 Hall, *Herman Christiaan van*, Prof. Groningen. Beschryving van de voorming en ontwickeling der zaden van *Crinum capense* Herb., met opmerkingen over de deelen van het zaad en over kieming, ook bij eenige andere Monocotyledonae. In Tydschr. von Nat. Gesch. en Phys. Deel VII. Amst. 1840. 8vo. pp. 140—164, pl. III.

We have not seen this.

Hanbury, *Daniel*, see **Flueckiger.**

178 Harvey, *William Henry*, Prof. Bot. Dublin, b. 1811, d. 1866. *The genera of South African plants arranged according to the natural system. Cape Town, 1838. 8vo. pp. i.—lxvi., 1—429.—Second Edition, Edited by J. D. Hooker, M.D. Cape Town, J. C. Juta. London (Longman). 1868. 8vo. 1—12, i.—lii., 1—483.

The merits of the first edition, considering the material on which Harvey had to work and his distance from the great sources of reference, were remarkably great; and the work became at once the foundation of all botanical study within the Cape Colony. The brief and necessarily incomplete sketch of the genera of Cape Musci, Hepaticae and Algae, with ordinal characters of Lichenes, Characeae and Fungi, has been omitted in the 2nd edition. (Sells 5*s*. to 10*s*.)—The second edition was a posthumous work, left only partially completed by Harvey, and published with the co-operation of Dr M. T. Masters for *Restiaceae*, Gen. Munro, C.B., for *Gramineae*, and J. G. Baker for *Filicales*, with Sir J. D. Hooker as general editor. It is unquestionably the most useful book existing on Cape botany for the purposes of the student at the outset. For an appendix by one of the authors of this compilation see Art. 318. (Publ. 18*s*.)
Libr. S. Afr., P.E., Gr. Rt., MacOw., Fairbr., Bol.

179 Harvey, *William Henry.* *On two new species of a new South African genus of the Natural Order Rhizantheae of Blume. In the Annals of Nat. Hist., vol. II. London, 1839. 8vo. pp. 385—388, plates XIX., XI

Describes two species of *Mystropetalon.*

180 —— *On two South African Genera of the Natural Order Passifloreae. In the Annals of Nat. Hist., vol. III. London, 1839. 8vo. pp. 420—421, plates IX., X.

Describes species of Acharia and Ceratosicyos.

181 —— *On a new South African Genus of Plants of the order Thymeleae. In Hooker's Journ. of Bot., vol. II. London, 1840. 8vo. pp. 265—6, with figure (Tab. X.).

Describes *Peddiea africana*, Harv.
Libr. MacOw., Bol.

182 —— *Description of *Christya*, a new genus of Apocynaceae from the Cape of Good Hope, with remarks on some other Cape plants of that order. In Hooker's Journ. of Bot., vol. IV. London, 1842. 8vo. pp. 133—136, with plate (Tab. XXI.).

An excellent figure of a curious Eastern Province plant, identical, as pointed out by Benth and Hook fil. Gen. Plant., with *Strophanthus capensis, A. DC.* (Bot. Mag. t. 5713.)
Libr. MacOw., Bol.

183 —— *New Genera of South African Plants. In Hooker's Lond. Journ. of Bot., vol. I. London, 1842. 8vo. pp. 18—30.

Libr. S. Afr.

184 —— *Account of a new genus of the order Hydrocharideae from S. Africa. In Hooker's Journ. of Bot., vol. IV. London, 1842. 8vo. pp. 230—231, with plate, tab. 22.

Contains figure and description of *Lagarosiphon muscoides*, Harv. A corrected transcript of the technical part of the memoir appears in Walpers's Ann. Bot. Systematicae (auct. C. Mueller, Berol.). Lipsiae, 1861. 8vo. Vol. VI. p. 14.
Libr. MacOw., Bol.

185 —— *On *Faurea*, a new genus of Proteaceae. In Hooker's Lond. Journ. of Bot., vol. V. London, 1846. 8vo. p. 373, with plate (tab. 15).

Libr. MacOw., Bol.

186 —— *Thesaurus Capensis: or, Illustrations of the South African Flora, being figures and brief descriptions of South African plants, selected from the Dublin University Herbarium. Vol. I. Dublin, 1859. 8vo. p. 68, plates 1—100.—Vol. II. ib. 1863. 8vo. p. 68, plates 101—200.

Valuable for Cape Eastern and Natal plants not yet incorporated into the Flora Capensis. (Pub. 40*s.*)
Libr. S. Afr., P.E., Gr. Rt., MacOw., Fairbr., Bol.
*** See also Lindley, Art. 292.

187 Harvey, *W. H.*, and *Otto Wilhelm* **Sonder.** *Flora Capensis, being a systematic description of the plants of the Cape Colony, Caffraria, and Port Natal. Vol. I. Dublin and Cape Town, 1859—60. 8vo. pp. 1—20, i.—xxxviii., 1—546 (Ranunculaceae to Connaraceae). Vol. II. ib.

51—62. 8vo. pp. i.—ix., 1—621 (Leguminosae to Loranthaceae). Vol. III. 1864—65. 8vo. pp. i.—x., 1—633 (Rubiaceae to Campanulaceae).

This important work, the progress of which was arrested by Dr Harvey's death in 1866, was undertaken under the auspices of the Colonial Government, and aided by a grant therefrom. It has not yet been resumed. The work, so far as published, is entirely in English, in which respect and in its general arrangement, it is uniform with a series of British Colonial Floras which have been issued during the last twenty years. (Pub.: vols. 1 and 2 at 12*s.* each, vol. 3, 18*s.*)

Libr. S. Afr., P.E., G.T., Gr. Bt., MacOw., Fairbr., Bol.

188 Haworth, *Adrian Hardy,* b. 1772, d. 1833. *Observations on the genus *Mesembryanthemum*, in two parts, containing scientific descriptions of above 130 species. London, 1794. 8vo. 480 pp.

189 —— *Miscellanea Naturalia sive dissertationes variae ad historiam naturalem spectantes. Londini, 1803. 8vo. pp. 204.

Treats chiefly of the genera *Mesembryanthemum*, *Tetragonia*, *Portulaca*, and *Saxifraga*.

190 —— *A new arrangement of the genus *Aloe*. In Trans. Linn. Soc., vol. VII. London, 1804. 4to. pp. 1—28.

Libr. Bol.

191 —— *Synopsis plantarum succulentarum cum descriptionibus, synonymis, locis; observationibus Anglicanis, culturaque. Londini, 1812. 8vo. pp. viii., 334.

—— Editio usui hortorum Germaniae accommodata (curavit F. v. P. Schrank). Norimbergae, 1819. 8vo. viii., 372 pp. (London ed. publ. 10*s.* 6*d.*)

Libr. S. Afr., MacOw.

192 —— *Supplementum plantarum succulentarum, sistens plantas novas vel nuper introductas sive omissas in synopsi plant. succ. cum obs. variis Anglicanis. Adjunctur Narcissearum revisio. Londini, 1819. 8vo. pp. xx., 158. (Publ. 5*s.*)

Libr. S. Afr. (bound up with preceding), MacOw.

193 —— *Saxifragearum enumeratio. Accedunt revisiones plantarum succulentarum. Londini, 1821. 8vo. pp. xx., 207. (Publ. 10*s.* 6*d.*)

Libr. MacOw.

194 —— *Plantae Rarae Succulentae. In Edinburgh Philosophical Magazine. Edinburgh, 1823. 8vo. p. 2.

Describes 5 Cape species.

Libr. MacOw.

195 —— *Observations on the *Mesembryanthema* Barbata. London, 1824. 8vo. 2 pp.

Describes 5 species.

196 —— *An account of the *Mesembryanthema* Ringentia. London, 1824. 8vo. 2 pp.

Describes 5 Cape species.

197 Haworth, *Adrian Hardy.* *Decas Novarum Plantarum Succulentarum. London, 1824. pp. 185—192.

Describes Cape species from Bowie's collections.

198 —— *Decas Secunda Nov. Plant. Succ. London, 1824. 8vo. 4 pp.

Contains species of Cape Aloes sent by Bowie.

199 —— *Decas Tertia Nov. Plant. Succ. London, 1824. 8vo. pp. 423—428.

Contains *Mesembryanthema* from Bowie.

200 Heister, *Lorenz,* Prof. Helmstadt, b. 1683, d. 1758. Descriptio novi generis plantae ex bulbosarum classe cui *Brunsvigiae* nomen imposuit. Brunsvigae, 1753. Folio. pp. 28. Tab. col. 3.

201 —— *Beschreibung eines neuen Geschlechts von einer sehr raren u. überaus schönen afrikanischen Pflanze aus der Familie der Zwiebelgewächse...*Brunsvigia,* etc. Braunschweig, 1755. Fol. max. 40 pp., 3 tab. col.

An edition in German of the foregoing. The plates representing *Brunsvigia multiflora,* Ait., of the natural size, are excellent.
Libr. MacOw.

202 Herbert, Hon. and Rev. *William,* b. 1778, d. 1847. *An appendix [to the Botanical Register, containing a treatise on bulbous roots, *Amaryllis, Brunsvigia,* &c.]. London, 1821. Large 8vo. 52 pp., 4 plates (2 coloured). (Publ. 5*s.*)

A treatise preliminary to the following.
Libr. Bol.

203 —— *Amaryllidaceae; preceded by an attempt to arrange the monocotyledonous orders, and followed by a treatise on cross-bred vegetables, and supplement. London, 1837. Roy. 8vo. pp. vi., 428, 48 col. plates.

(Publ. £3. 8*s.*, now somewhat rare, priced £2. 12*s.* 6*d.*)
Libr. S. Afr.

204 Hermann, *Paul,* Prof. Bot. Leyden, b. 1640, d. 1695. *Horti Academici Lugduno-Batavi Catalogus, exhibens Plantarum omnium nomina quibus ab anno 1681 ad annum 1686 Hortus fuit instructus et plurimarum—descriptiones et icones. Lugd. Bat. 1687. 8vo. pp. i.—ix., 1—700, 106 tab. aen.

Thirty-four of the neat engravings in this descriptive alphabetical catalogue represent Cape plants. Like many botanical drawings of the time the scale is not uniform, and has been regulated solely by the size of the page.
Libr. MacOw.

205 —— *Paradisus Batavus, innumeris exoticis curiosis herbis et rarioribus plantis magno sumtu et cura ex variis terrarum orbis regionibus tam oriente quam occidente collectis, acquisitis, illustratus. Ingeniosissima et dexterrima artificum manu elaboratis iconibus ad vivum aeri incisis; cui accessit catalogus plantarum, quas pro tomis nondum editis delineandus cura-

trat. Opus posthumum edidit William Sherard. Lugduni Batavorum, 1698. to. 247, 15 pp., 111 tab.

Another edition, dated 1705, 4to., only differs in its title page. The plates are finely executed and include a few Cape plants.
Libr. MacOw.; also Bol. (plates only).
See also under Burman, Art. 98, two catalogues of Cape plants by this author.

206 **van Heurck** and **Mueller,** *Joh.* (Argov). *Observationes Botanicae et descriptiones plantarum novarum herbarii van Heurckiani. Anvers and Berlin, 1870. 8vo. pp. 1—117.—Fasc. II. id. 1871.

In fasc. 1 two new Ericae are described, and in fasc. 2 a var. of *Combretum erythrophyllum*, Sond., all from Zeyher's collections.

207 **Hiern,** *William Phillip.* *†A Monograph of Ebenaceae. In Transactions of the Cambridge Philosophical Society, vol. XII., part 1. Cambridge, 1873. 4to. pp. 27—300, with 11 plates.

A model of botanical erudition and conscientiously accurate work. Thirty South African species, including those of Delagoa Bay, are described.
Libr. S. Afr., MacOw., Fairbr., Bol.

208 —— *Notes on Ebenaceae, with description of a new species. In Trimen's Journal of Botany, vol. III. N.S. London, 1874. 8vo. pp. 238—240.

Libr. MacOw.

209 —— *Further notes on Ebenaceae, with description of a new species. In Trim. Journ. Bot., vol. IV. N.S. Lond. 1875. 8vo. pp. 353—357, with plate.

These two additional memoirs contain but slight references to South African species.
Libr. MacOw.

210 **Hochstetter,** *Christ. Friedr.*, Prof. Esslingen, b. 1787, d. 1860. *Pflanzen des Cap- und Natallandes. In the Regensburg Bot. Journ. "Flora." 1845. p. 342.

An enumeration of Dr Ferd. Krauss's plants collected in Natal.
Libr. MacOw.

211 —— *Nova Genera Plantarum Africae tum Australis tum tropicae borealis. Regensburg, 1842. 8vo. 32 pp.

From the Regensburg "Flora" for the years 1841, 1842.
Libr. MacOw.

212 **Hooker,** Sir *William Jackson*, Director Bot. Gardens, Kew, b. 1785, d. 1865. *Botanical Miscellany; containing figures and descriptions of such plants as recommend themselves by their novelty, rarity, or history, &c. London, 1830—33. 3 vols., 8vo.—I. 1830. 356 pp., plates 1—75.—II. 1831, 421 pp., plates 76—95.—III. 1833, 390 pp., plates 96—112, suppl. col. plates 21—41.

Libr. S. Afr.

213 —— *The Journal of Botany, being a second series of the Botanical Miscellany; containing figures and descriptions of such plants as recommend themselves by their novelty, rarity, or history, or by the uses

to which they are applied in the arts, in medicine, and in domestic oeconomy together with occasional botanical notices and information. London, 1834-1842, 4 vols. 8vo.—I. 1834, 390 pp., 28 plates, part col'd., numbered 113—14—II. 1840, 442 pp., 16 plates, portrait of Olof Swartz.—III. 1841, 446 pp., plates, portrait of Jussieu.—IV. 1842, 433 pp., plates 18—25, portraits Richard, and of A. Cunningham.

Contains many papers and notices relating to Cape Botany.
Libr. S. Afr., MacOw., Bol.

214 Hooker, Sir *William Jackson.* *The London Journal Botany containing figures and descriptions of such plants as recommend themselves by their novelty, rarity, history or uses; together with botanical notices and information and occasional portraits and memoirs of eminent botanists London, 1844—48. 7 vols. 8vo.—I.: 1842. 678 pp., 23 plates.—II.: 1843 678 pp., 24 pl.—III.: 1844. 666 pp., 24 pl.—IV.: 1845. 666 pp., 24 pl.—V. 1846. 666 pp., 24 pl.—VI.: 1847. 612 pp., 24 pl.—VII.: 1848. 674 pp., 23 tab

Contains many valuable memoirs on Cape plants, most of which will be found under the authors' names. (Publ. £12. 12*s*.)
Libr. S. Afr.; and Bol. (vol. I. excepted).

215 —— *Description of three species of *Podocarpus.* In Hooker's Lond. Journ. of Bot., vol. I. London, 1842. 8vo. pp. 656—659, with 3 plates.

Describes and figures a Cape species, *P. Thunbergii*, Hook.
Libr. S. Afr.

216 —— *Journal of Botany and Kew Garden Miscellany. 9 vols. London, 1849—57. 8vo.—I.: 1849. 386 pp., 12 plates.—II.: 1850. 386 pp., 12 pl.—III.: 1851. 384 pp., 12 pl.—IV: 1852. 354 pp., 12 pl.—V: 1853. iv., 416 pp., 12 pl.—VI.: 1854. 386 pp., 12 pl.—VII: 1855. 386 pp., 12 pl.—VIII.: 1856. 386 pp., 12 pl.—IX: 1857. 386 pp., 12 pl.

Libr. S. Afr.

217 —— *Icones Plantarum; or figures with brief descriptive characters and remarks of new or rare plants selected from the Author's herbarium. Vols. 1—10. London, 1837—1854. 8vo. Plates 1—1000, and text.—Third series by Joseph Dalton Hooker (plants selected from the Kew Herbarium). Vol. XI. 1867—71, plates 1001—1100, with text.—Vol. XII. 1872—76, plates 1101—1200, with text.—Vol. XIII. 1877—79, plates 1200—1300, with text.—Vol. XIV. 1880— , parts 1, 2, 3, plates 1301—75.

A valuable series, including many rare and critical Cape plants (Publ. £1. 8*s*. per vol. Complete sets are now scarce, selling about £12. 10*s*.).
Libr. Bol., also MacOw. (incomplete).

218 Hooker, Sir *Joseph Dalton,* Director Royal Gardens, Kew, b. 1817.——*On the plants of the temperate regions of the Cameroons mountains and Islands in the Bight of Benin, collected by Gustav Mann. In the Journal of the Linnean Society. Vol. VII., pp. 172—240, with a plate.

Contains much interesting detail. Comparing the Flora of temperate West Africa with that of South Africa.
Libr. MacOw., Bol.

219 Hooker, Sir *Joseph Dalton.* *On *Welwitschia*, a new genus of Gnetaceae. In Transactions of the Linnean Society. Vol. XXIV. London, 1863. 4to. pp. 1—48, with 14 fine plates.

A masterly monograph respecting the celebrated "Tumboa" of Mossamedes Bay. Compare the account given by J. J. Monteiro in "Angola and the River Congo," Art. 345.
Libr. MacOw.

——— The Genera of South African Plants, see **Harvey,** *W. H.*

220 —— *On *Melianthus Trimenianus*, Hook. fil. and the affinities of *Greyia Sutherlandi*, Harv. In Trimen's Journal of Botany, vol. II. N.S. London, 1873. 8vo. pp. 353—358, with coloured plate.
Libr. MacOw., Bol.

221 —— *On the sub-Alpine vegetation of Kilima-Njaro, E. Africa. In Journ. of Linn. Soc. vol. XIV., pp. 141—146.
Points out the S. African forms found in this distant locality.
Libr. MacOw., Bol.

——— Genera Plantarum. See **Bentham,** *G.* and *J. D.* **Hooker.** Art. 67.

222 —— *On the discovery of *Phylica arborea*, Thouars, a tree of Tristan d'Acunha, in Amsterdam Island, with an enumeration of the Phanerogams and Vascular Cryptogams of that Island and of St. Paul. In Journal of Linn. Soc., vol. XIX. Lond. 1875. 8vo. pp. 474—482.
Libr. MacOw., Bol.

223 Houttyn, *Martin.* *†Natuurlyke historie oft uitvoerige beschryving der dieren, planten, en mineraalen volgens het samenstel van Linnaeus. Deel II.: Planten. XIV Stuk. Amsterdam, 1774—1783. 8vo. Tab. 1—105.
Part XIV. contains figures and descriptions of Cape plants. Of little value.

Cryptogamic Botany.

224 Harvey, *W. H.*, M.D. *Nereis Australis, or Algae of the Southern Ocean: being figures and descriptions of marine plants collected on the shores of the Cape of Good Hope, the extra tropical Australian Colonies, Tasmania, New Zealand, and the Antarctic regions, deposited in the Herbarium of the Dublin University. Part 1. 2. London, 1847—49, imp. 8vo. pp. viii., 124, col. plates 1—50.
Libr. S. Afr., P.E.

225 —— **Wardia:* a new genus of Mosses discovered in Southern Africa. In Hooker's Companion to the Bot. Mag. London, 1836. 8vo. Vol. II., pp. 183—4. 1 col. plate.
Libr. S. Afr.

226 Hampe, *Ernst,* b. 1795, d. 1880. **Notarisia* novorum Muscorum genus, propositum ab E. Hampe Blankenburgensis in Linnaea. Vol. XI. Halle, 1837, p. 379.

Three mosses, of which one belongs to the Cape, are here described. For a fuller account of the Cape species see Hornschuch, Musc. Frond. Descriptiones in Linnaea vol. XV. pp. 126—129, where it appears as *Brachysteleum crispatum*, Hornsch.
Libr. MacOw.

227 Hampe, *Ernst* [Descriptions of Mosses]. In Botanische Zeitung. Leipzig, 4to. 1870.

Four Natal mosses from the collection of Borgen are here described.

228 Hedwig, *Johann*, Prof. Bot. Leipsic., b. 1730, d. 179[illegible]. *Species muscorum frondosorum descriptae et tabulis aeneis coloratis illustrata. Opus posthumum, editum a Fr. Schwaegrichen. Lipsiae, 1801. 4to. VI. 352 pp. 77 tab. col.—Supplementum I. Vol. 1. 1811. XXI. 196 pp. tab. I.—XLIX. Vol. 2. 1816. VII. 373 pp. tab. L—C.—Suppl. II. Vol. 1. 1823—24.—VI., 186 pp., tab. CI—CL. Vol. 2. 1826—27. 210 pp., tab. CLI—CC.—Suppl. III. Vol. 1. 1827—28. (180 pp.), tab. CC—CCL. Vol. 2, 1829—30 (168 pp.), tab. CCLI—CCC.—Suppl. IV. Vol. 1. Sect. 1. 1842 (100 pp.), tab. CCCI.—CCCXXV. (100 Th :—in charta velum : 133⅓ Th).

Contain many Cape species (offered by Voigt, 1879, 130 marks).
Libr. S. Afr.

229 Hering, *Karl*, b. 1796, d. 1843. [Memoir on Krauss's Algae.] In Annals and Mag. of Natural History. 1842.

We have not seen this.

230 Hooker, Sir *William Jackson*. *Musci Exotici, containing figures and descriptions of new or little-known foreign mosses and other cryptogamic subjects. London, 1818—1820. 2 vols. 4to. Vol. 1. 1818. Plates 1—96 with text (unpaged). Vol. 2. 1820. Plates 97—176 with text (unpaged).

Contains plates of eight Cape mosses and one Helenian, collected by Menzies, Brown and Burchell. (Pub. col. £4. 4*s*.; plain £2. 2*s*.).
Libr. S. Afr.

231 Hooker, Sir *W. J.* and *J. G.* **Baker.** *Synopsis Filicum, a Synopsis of all known Ferns, including the Osmundaceae, Schizeaceae, Marattiaceae, and Ophioglossaceae (chiefly derived from the Kew Herbarium) accompanied by figures representing the essential characters of each genus. London, 1868. 8vo.—2nd ed. London, 1874. 8vo. pp. i.—xiv, 9—559. 9 plates with 9 pp. descriptive text.

The most recent enumeration of this important order, and indispensable to the student.
Libr. S. Afr., P.E., MacOw.

232 Hornemann, *Jens Wilken*, b. 1770, d. 1841. *Om Fucus buccinalis L. In Selsk. naturvid. og mathem. Afh. III. [1828] pp. 381—390. 1 tab. col. [no title page or date].

Libr. MacOw.

233 Hornschuch, *Christian Friedrich*, b. 1793, d. 1850. *Musci frondosi exotici herbarii Willdenowiani, tum capenses a Bergio lecti, tum alii quidam ex Australasia aliisque orbis terrarum plagis a Chamisso relati. In Horae Physicae Berolinenses. Ed. C. G. Nees von Esenbeck. Bonn, 1820. folio I.—XII., 1—123, ind. 1—4. 27 tab. col.

The two plates belonging to this section contain exquisite figures of 5 Cape Musci. The Bergius (C. H.) above cited was the second Cape collector of that name, a young German apothecary who died shortly after his arrival here in 1820. (Sells £12. 15*s*.) See Art. 416.
Libr. MacOw., Bol.

234 Hornschuch, *Christian Friedrich.* *Muscorum Frondosum novorum, quos in Africa Australiori collegerunt Ecklon, Drège, Mundt & Maire descriptiones. Adjectae sunt adnotationes de nonnullis aliis muscis spensibus jam divulgatis. In Linnaea. Vol. xv. Halle, 1841. 8vo. pp. 14—157.

Contains descriptions of 45 species of Cape mosses. A continuation was promised but does not seem to have appeared.
Libr. MacOw., Bol.

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Phanerogamic Botany.

235 Jacquin, *Joseph Franz,* b. 1766, d. 1839. Eclogae plantarum rariorum aut minus cognitarum quas ad vivum descripsit et iconibus coloratis illustravit. Vindobonae, 1811—44. 2 vols. fol.—I.: 1811—16, pp. VIII., 155. tab. col. 1—101.—II.: Post obitum Jacquini ab auctoris filia Isabella a Schreibers evulgatum. Synopsin specierum cum indice adjecit Eduard Fenzl. 1844. 11 pp., ind., tab. col. 101—169. (Plate 157 did not appear.)

Said to contain plates of some Cape plants.

236 —— Synopsis Stapeliarum in quatuor fasciculis prioribus Monographiae Jacquinianae descriptarum. (Viennae) 1816. 8vo. 12 pp.

Unknown to us.

237 Jacquin, *Nicolaus Joseph,* Prof. Chem. and Bot. Schemnitz, Vienna, b. 1727, d. 1817. *Observationum botanicarum iconibus ab auctore delineatis illustratarum. Pars. I.—IV. Vindobonae, 1764—71. folio. 48, 32, 22, 14 pp., 100 tab. (Pub. 10 Th.)

Libr. MacOw.

238 —— *Hortus botanicus Vindobonensis, seu plantarum rariorum, quae in horto botanico Vindobonensi, etc., coluntur, icones coloratae et succinctae descriptiones. Vindobonae, 1770-76. III. voll. folio :—I.: 1770, pp. 1—44, tab. col. 1—100.—II.: 1772. pp. 45—95, ind., tab. col. 101—200. III.: 1776. 52 pp., ind., 100 tab. col.

Only a small proportion of the plates in this work are of Cape plants (Pub. 250 Th.)

239 —— *Icones Plantarum Rariorum. Vindobonae, 1781—93. III. voll. folio. I.: 1781—86, praef (2), 20 pp., tab. col. 1—200. II.: 1786—93. 22 pp., tab. col. 201—454. III.: 1786—93. 24 pp., tab. col. 455—648. (A duplicated number, 286*, brings the total number of plates to 649.)

A large proportion of the plants figured in this fine work are South African. (Pub. 270 Th. Priced at £12 to £15.)
Libr. Bol.

240 —— *Collectanea ad botanicam, chemiam et historiam naturalem spectantia cum figuris. Vindobonae, 1786—96. 5 vols. 4to. I.: 1786. 386 pp., 22 tab. col. II.: 1788. 374 pp., 18 tab. col. III.: 1789, 306 pp.,

23 tab. col. IV.: 1790, 359 pp., 27 tab. col. V: supplementum. 1796, I pp., 16 tab. col.

Contains figures of several Cape plants and full descriptions of many those of which the figures only (without descriptions) appear in the Icon Plant. Rarior. (Pub. 53½ Th. Priced at 30*s.* to 40*s.*)
Libr. MacOw., Bol.

241 **Jacquin,** *Nicolaus Joseph.* *Oxalis Monographia iconib illustrata. Viennae, Lond. et Lugd. Bat. 1794. 4to. pp. 1—120, sche tab. 1—81 (quarum 75 col.)

All, excepting a few, are excellent plates of this characteristic Cape genu (Pub. 15 Th. Priced, 1878, 45*s.* to 57*s.*)
Libr. S. Afr., Bol.

242 —— *Plantarum rariorum horti caesarei Schönbrunnen sis descriptiones et icones. Viennae, 1797—1804. 4 vols. folio. I.: 1797 XII., 70 pp., tab. col. 1—129. II.: 1797, 68 pp., tab. col. 130—250. III.: 1798 80 pp., tab. col. 251—400. IV.: 56 pp., tab. col. 401—500.

A large number of the fine hand-coloured plates represent S. African plants. (Pub. 280 Th. Priced, £12 to £18.)
Libr. S. Afr., Bol.

243 —— *Stapeliarum in hortis Vindobonensibus cultarum descriptiones figuris coloratis illustratae. Vindobonae, 1806. folio. (64 foll.) praef., ind., 64 tab. col.

"The work was completed in 1819 by Jos. Fran. von Jacquin, son of the author." Pritzel. There is but one copy, and that an extremely imperfect one, of this very rare work, in the Colony, deposited in Libr. S. Afr. It wants the Index and thirty-three plates.

244 —— *Fragmenta botanica figuris coloratis illustrata, ab anno 1800 ad annum 1809 per sex fasciculos edita. Viennae, 1809. folio, 86 pp., ind., 138 tab. col.

Contains figures of a few Cape plants.

245 **Jackson,** *John Reader.* Saffron from *Lyperia crocea*, Eckl. In Pharmaceutical Journal, May 11, 1872. London, p. 904.

A repetition of Pappe's notice of this dye (Geel-bloemmetjes) in Prod. Flor. Med. Cap. p. 37.

246 **Jarosz,** *Franz Eduard Felix*, b. 1799. *Plantae novae Capenses. Dissertatio inauguralis, &c. Berol. 1821. 8vo. 24 pp.

A tract of little value. Chamisso and Schlechtendal in their revision of the Gentianeae of the Romanzoff expedition (Linnaea I. 191) declare that they can make nothing of the author's descriptions, and have thought it best to pass over in silence "quae iste paucissimis notus libellus atque obscurus in lucem proferre conatus sit." By an oversight *Chironia emarginata*, Jarosz, p. 11, was omitted in Grisebach's recension of the order in De C. Prodromus IX. p. 89. Cf. Walp. Ann. Bot. Syst. I. p. 514.
Libr. MacOw.

247 **de Jussieu,** *Adrien*, b. 1797, d. 1853. Mémoires sur les Rutacées on considérations sur ce groupe de plantes, suivies de l'exposition des genres qui les composent. Paris, 1825. 4to. 160 pp., 16 tab. (sign 14—29).

Unknown to us. (Pub. 15 fr.)

248 **de Jussieu,** *Adrien.* [On Penaeaceae.] In Annales des sciences Naturelles. Ser. III. Vol. VI. p. 15, tab. 1—3.

The title of this memoir is unknown to us.

Cryptogamic Botany.

249 **Jaeger,** *August*, d. 1877. *Genera et Species Muscorum systematice disposita seu Adumbratio Florae Muscorum totius Orbis terrarum. Separat abdrucke aus den Verhandlungen der St Gallischen naturw. Gesellschaft. 1870—74.—Vol. I.: Musci Acrocarpi. San Galli. 1871—1875. 8vo. pp. i.—iii., 246—299, 357—451, 310—490, 61—236, 54—278.—Vol. II.: 1876—1879 (Verhandlungen 1875—1878). pp. i.—iv. 85—188, 201—371, 1—454, 521—778. Index, with title of vol. I. repeated, i.—xl.

Contains the latest systematic catalogue of Musci generally, and therefore of those of the Cape. It shews that very many species are lying *perdu* in Herbaria under MS. names awaiting publication. The seventh and subsequent sections have been revised and partly elaborated by the deceased author's friend, Dr F. Sauerbeck.
Libr. MacOw.

K

Phanerogamic Botany.

250 [**Ker,** *John Bellenden*, formerly **Gawler.**] *Strelitzia* depicta, or coloured figures of all the known species of the genus *Strelitzia*, from the drawings in the Banksian Library by Francis Bauer. London, 1818. Folio. Fasc. I., II.: col. plates 1—8.

This is doubtless the same work recorded under **Bauer,** Art. 58, but we are unable to explain the differences. The attribution to **Ker** is taken from Pritzel.

251 —— Iridearum Genera, cum ordinis charactere naturali, specierum enumeratione synonymisque. Bruxellis, 1827. 8vo. 158 pp.

*** This writer was also the author of all the descriptions of plants in the Botanical Register (Art. 163) from the years 1815 to 1824, which are not otherwise stated.

252 **Klatt,** *Friedrich Wilhelm.* *Revisio Iridearum.—Beitrag zur Kenntniss der Irideen.—Diagnoses Iridearum Novarum. In Linnaea, vols. XXXII., XXXIV., XXXV. Halle, 1863—66. 8vo.

A monograph of the order. Respecting its value and deficiencies, see Baker, Syst. Iridacearum supra, Art. 42.
Libr. MacOw., Bol.

253 —— *Ueber die Gattung *Euparea*, Banks (Gaertner). In Linnaea, vol. I. New Series. Berlin, 1867. 8vo. pp. 394—395.

The author identifies *Euparea amoena*, Soland., and also *Anagallis Huttoni*, Harv. (from the Cape) with *Anagallis tenella*, Linn.
Libr. Bol.

254 Klatt, *Friedrich Wilhelm.* *Beitraege zur Kenntn der Compositen Sued-Afrikas. In Linnaea, vol. XLIII. Berlin, 1878– 8vo. pp. 503—510.

An enumeration merely of three small collections of Cape Compositae, v 74 species collected by Dr Meyer in the Hantam Mts.; 44 species of Ecklon & Krebs; and 22 species of Fr. de Castelnau.
Libr. Bol.

255 Klinsmann, *Ernst Ferdinand,* b. 1794, d. 1865. *†Clav Breyniana, oder Schluessel zu Jacobi Breynii Gedanensis Exoticarum aliar que minus cognitarum plantarum centuria prima cum figuris etc., und Johannis Philippi Breynii Icones fasciculi rariorum plantarum primus secundus, bearbeitet und mit einigen Anmerkungen herausgegeben von E. Klinsmann, Med. et Chirurg. Dr. Danzig, 1855. 4to. pp. i.—v., 1—20.

The descriptive names of the older work and those of the modern nomenclature are given in parallel columns, the latter chiefly after Willdenow. Possessors of this work may note the following emendations: tab. 12 is undoubtedly *Stoebe cinerea,* Thunb. Tab. 38: leaves (probably of some *Antheric* (*Bulbine*)) mismatched with the spike of some *Watsonia.* Tab. 40, left blan by Klinsmann, is *Drimia elata,* Jacq. Tab. 47: "Centaureum minus," &c. doubtless a Cape *Lebaea* (the colour of flowers is frequently erroneously de scribed from dried specimens, as e.g. where *Lobelia* (*Parastranthus bitens* A. de C.) is described as "Coeruleo flore"). Tab. 71 is clearly *Helichrysu nudifolium,* Less.
Libr. MacOw.

256 —— *Clavis Dilleniana ad hortum Elthamensem. Danzig 1856. 4to. 31 pp.

Exactly similar in design to the Clavis Breyniana. These two opuscula are of great service when consulting the fine old works to which they refer.
Libr. MacOw.

257 Klotzsch, *Johann Friedrich,* Keeper Roy. Herb. Berlin, b. 1805, d. 1860. *Ericearum a cel. Adelberto de Chamisso descriptarum. Pars addita. In Linnaea, vol. VIII. Berlin, 1833. 8vo. pp. 655—668. Vol. IX. pp. 350—367, and 611—706. Vol. X. pp. 312—355. Vol. XII. pp. 211—247, and 497—543.

The connexion of Chamisso's name with this elaborate monograph of Cape Ericeae is not clear. In vol. I. p. 511, and VIII. p. 491, there are memoirs of his upon the Ericeae of sub-arctic America and Brazil, but no Cape species, nor even the genus Erica itself is mentioned.
Libr. S. Afr., MacOw., Bol.

258 —— *Bemerkung zur Gattung *Grubbia,* Endl. In Linnaea, vol. XIII. Halle, 1839. pp. 378—381.
Libr. MacOw., Bol.

259 Kniphof, *Johann Hieronymus,* Prof. Med. Erfurt, b. 1704, d. 1763. Botanica in Originali seu Herbarium vivum plantarum tam indigen. quam exotic. peculiari quadam operosoque enchiresi, atramento impressorio obductarum nominibus suis ad methodum Linnaei et Ludwigii insignitarum elegantissima ectypa exhibentur opera et studio Joh. Godofr. Trampe, typographi Halensis. Halae, 1757—1764. Folio.—XII. Centuriae vel II voll. 1254 fuligine imper. pict.—Accedit: Index Universalis. Halae, Trampe 1767. Folio. 14 pp. (36 th.).

Quoted by the later writers of the 18th cent. as containing figures of Cape plants. We have not seen the work.

260 **Kolbe,** *Peter,* b. 1675, d. 1726. *Beschreibung des gebirgs der guten Hoffnung und der Hottentotten. Nürnberg, 1719. o. Tab.

A catalogue of indigenous plants and descriptions taken from Hartog, Oldenland and elsewhere are contained in this curious old book. An edition in Dutch was published at Amsterdam in 1727.
Libr. S. Afr., MacOw. (Dutch ed.).

261 **Krauss,** *Ferdinand.* *Beitrage zur Flora des Cap- und tal-landes. Regensburg, 1846. 8vo. 215 pp., 2 tab.

The first 24 pages of this useful memoir contain sketches of the vegetation of such parts of the Colony and Natal as were visited by Krauss during the years 1838—40. The remainder forms an extended catalogue of species, with many novelties here first described, and may be considered as a supplement to Drège's Documente, especially with regard to Natal localities. Cryptogams are included.
Libr. MacOw.

262 **Kretzschmar,** *Eduard.* Südafrikanische Skizzen. Leipzig, 853. 8vo. viii., 382 pp.

Contains an account of Cape medical plants on pp. 123—144. (Unknown to us.)

263 **Kunth,** *Karl Sigismund,* Prof. Bot. Berlin, b. 1788, . 1850. *Ueber die Thymeleen, und eine neue, ihnen verwandte Pflanzenamilie, die Penaeaceen. In Linnaea, vol. v. Berlin, 1830. 8vo. pp. 667—78.

Libr. S. Afr., MacOw., Bol.

264 —— *Vier botanische Abhandlungen. Gelesen in der Akademie der Wissenschaften. den 24 Marz. 1831. Ueber die Verwandtschaft der Gattung *Stilbe;* ueber die Gattung *Sympieza,* Licht. &c. Berlin, 1832. 4to. 16 pp.

Libr. MacOw.

265 —— *Enumeratio plantarum omnium hucusque cognitarum, secundum familias naturales disposita, adjectis characteribus, differentiis et synonymis. Stuttgardiae et Tubingae, 1833—50. 5 voll. 8vo.

Tomus I.: Agrostographia synoptica sive enumeratio Graminearum omnium hucusque cognit., adjectis charact., different. et synon. 1833. p. 606.

Supplementum tomi primi, exhibens descript. specierum nov. et minus cognit. 1835. 436 (40) pp., 40 tab.

Tomus II.: Cyperographia synoptica, sive enumeratio Cyperacearum omnium hucusque cognit., adjectis charact., different. et synon. 1837. 591 pp.

Tomus III.: Enumeratio Aroidearum, Typhin., Pandan., Fluvial., Juncagin., Alismac., Butom., Palm., Juncac., Phylidr., Restiac., Centrolepid. et Eriocaul. omnium huc. cognit., adj. charact. diff., et synon. 1841. 644 pp.

Tomus IV.: Enumeratio Xyridearum, Mayac., Commelyn., Pontederiac., Melanthac., Liliac., et Asphodel. omnium huc. cognit., adj. charact., diff. et synon. 1843. 572 pp.

Tomus V.: Enumeratio Asparaginearum, Smilacin., Lapageri., Roxburghiac., Herreri., Ophiopogon., Aspidiastr., Discorin., Taccac., et Amaryllid. 1850. 908 pp.

This work forms a Cyclopaedia of Endogenous Botany, and notwithstanding certain defects (see Preface to Baker's Revision of Herbaceous Capsular Liliaceae, Art. 25) is still the only work professing to give a complete description of certain

orders available to the student. In respect of Cape grasses the first w superseded by Nees von Esenbeck's Monograph (Art. 366) and Mr B Revisions put aside nearly all the Liliaceae. For Restiaceae see Ma (Art. 124), and for Juncaceae, **Buchenau** (Art. 91). (Pub. $14\frac{2}{16}$ Th. Copi procurable for 40*s.* to 50*s.*)
Libr. S. Afr., P.E., MacOw., Bol.

Cryptogamic Botany.

266 Kalchbrenner, *Karoly.* Uj Vagy Kevesbbe ismert S mörcsögfelek. (Phalloidei novi vel minus cogniti.) Kalchbrenner, Kar R. tagtol. From the Transactions of the Hungarian Academy of Scien vol. x. Buda-Pest, 1880. 8vo. pp. 1—24, 3 col. pl.

Contains descriptions and admirable figures of two Cape Phalloid Fu *Kalchbrennera* and *Anthurus*.
Libr. MacOw., Bol.

267 —— *Fungi MacOwaniani by C. Kalchbrenner. Grevillea, vol. IX. No. 51. London, 1881. pp. 108—116: No. 52. pp. 131 137.—Vol. X. No. 54. pp. 52—59.

These papers, together with that in the succeeding article, form the o extended catalogue of Cape Fungi, and enumerate 365 species.
Libr. MacOw.

268 Kalchbrenner, *C.* and *M. C.* **Cooke.** *South African Fun by C. Kalchbrenner and M. C. Cooke. In Grevillea, vol. IX. no. 49. Lond 1880. 8vo. pp. 17—34.

Enumerates 148 Cape species, among which are many novelties, briefly scribed, and some figured in pl. 135—138 of the subsequent nos. 50—51.
Libr. MacOw.

269 —— *Natal Fungi collected by J. M. Wood, Inand determined by M. C. Cooke, and the Hymenomycetes by Rev. C. Kalchbrenn In Grevillea, vol. X. no. 53. 1881. pp. 26—27.

Libr. MacOw.

270 Kaulfuss, *Georg Friedrich,* Prof. Bot. Halle, d. 183 *(Plantae Ecklonianae.) Lycopodiaceae et Filices. In Linnaea, vol. VI Berlin, 1831. pp. 181—187.

Libr. A.E., S. Afr., MacOw., Bol.

271 Krauss, *Christ. Ferd. Friedrich.* *†Beitrag zur Kenntniss der Corallineen und Zoophyten der Südsee, nebst Abbildungen der neuen Arten. Stuttgart, 1837. 4to. 38 pp., 1 tab.

Contains some Cape species, chiefly gathered in Mosset Bay.
Libr. S. Afr.

272 Kuetzing, *Friedrich Traugott,* b. 1807. Phycologia generalis, oder Anatomie, Physiologie, und Systemkunde der Tange. Leipzig, 1843. 4to. xxxii., 458 pp., 80 tab. col.

Libr. S. Afr. (Publ. 40 th.)

273 **Kuhn,** *Maximilian.* *Filices Deckenianae. Dissertatio inauguralis Botanica quam, &c., defendet auctor. M. Kuhn, Berolinensis. Lipsiae, 1867. 8vo. 28 pp.

The introduction treats of the distribution of African ferns. The entire opuscule is reprinted in the work following.
Libr. MacOw.

274 —— *Filices Africanae. Revisio critica omnium hucusque cognitorum Cormophytorum Africae indigenorum, additamentis Braunianis nonnullisque Africanis speciebus ex Reliquis Mettenianis adaucta. Accedunt Filices Deckenianae et Petersianae. Lipsiae, 1868. 8vo. 233 pp.

Invaluable as an index to everything published on Cape Ferns. The genera *Ophioglossum* and *Isoetes* are by the late Prof. A. Braun.
Libr. MacOw. (Prof. A. Braun's copy).

275 **Kunze,** *Gustav,* Prof. Bot. Leipsic, b. 1793, d. 1851. Plantarum acotyledonearum Africae Australioris recensio nova e Dregei, Ecklonі, et Zeyheri, aliorumque peregrinatorum collectionibus aucta et emendata. Particula prima, Filices Linn. complectens. Dissertio. Lipsiae, 1836. 8vo. 77 pp.

There is another impression of this opuscule on Cape ferns, reprinted from the Linnaea, vol. x. 1836, pp. 481—570, but with separate title-page, and independent pagination. This bears the imprint "Halis" (Halle am Saal), and has fourteen pages extra, containing "Index locorum omnium Africae Australioris uti Filices antea recensitae a Dregeo lectae sunt."
Libr. MacOw., Fairbr., Bol.

276 —— Die Farrnkräuter in colorirten Abbildungen naturgetreu erläutert und beschrieben. Schkuhr's Farrnkräuter, Supplement. Band 1, 2. Leipzig, 1840—51. 4to.—Band 1 (Lieferung 1—10). 1840—47. vi., 252 pp., effigies autoris, tab. col. 1—100.—Band 2 (Lieferung 11—14). 1848—51. pp. 1—98, tab. col. 101—140.

Contains seven Cape Ferns in the first four decades. (Publ. 35 Th. Priced at about 70*s.*)

277 —— *Filicum in Promontorio Bonae Spei et ad Portum Natalensem a Guienzio nuperius collectarum &c. In Linnaea, vol. XVIII. Halle, 1844. 8vo. pp. 113—124.

Describes several Cape Ferns.
Libr. MacOw., Bol.

L

Phanerogamic Botany.

278 **La Marck,** *Jean B. A. P. M.,* b. 1744, d. 1829. *Encyclopédie méthodique. Botanique. Paris, 1783—1817. 13 vols. 4to.—I.: 1873. A-Cho. xliv., 752 pp.—II.: 1786. Cic-Gor. 774 pp.—III.: 1789. Gor-Mau. viii., 759 pp.—IV.: 1797. Mau-Pan. vii., 764 pp.—V.: 1804. Pan-Pyx. viii., 748 pp.—VI.: 1804. Qua-Sci. 786 pp.—VII.: 1806. Sci-Tra. 731 pp.—VIII.: Tre-Zuc. 879 pp.—Supplement. IX.: 1810. A-Byt. xviii., 761 pp. —X.: 1811. Caa-Gyr. 876 pp.—XI.: 1813. Hab-Mor. 780 pp.—XII.: 1816. Mor-Ryn. 731 pp.—XIII.: 1817. Sa-Z, et Addenda. viii., 780 pp., with Atlas and 900 plates.

Contains descriptions and plates of many Cape plants. From vol. v. onward, the text is by J. L. M. Poiret.

La Roche, *see* **De la Roche.**

279 Langer, *Carl.* *Die Vegetationsformen des Kaplands und ihre Vergleichung mit denen der benachbarten afrikanischen Vegetationsgebiete. 8vo. 35 pp.

Apparently a reprint from the transactions of some learned society. There is no place or date on the title-page; the sheets are marked *Oberrealsch. Josefstadt.*—The paper is chiefly a reproduction of Grisebach's chapters on the Cape Flora in his Vegetation der Erde (Art. 173), with some unimportant additions.
Libr. Bol.

280 Lehmann, *Johann Georg Christian,* Director Bot. Gard. Hamburg, b. 1792, d. 1860. *Plantae e familia Asperifoliarum nucifera. Pars I. et II. Berolini, 1818. 4to. 478, ix. pp.

Contains 24 Cape species, mostly *Lobostemon* (under *Echium*).
Libr. S. Afr., MacOw.

281 —— *Icones et descriptiones novarum et minus cognitarum stirpium. Pars I. Icones rariorum plantarum e familia Asperifoliarum. Hamburgi, 1821. Folio. 28 pp., 50 tab.

Published in 5 fasciculi from 1821—24. Intended to illustrate the author's previous work "Plantae e fam. Asperif." Contains excellent figures of 13 Cape Boragineae. (Pub. 13 Th. Sells for 10*s.*)
Libr. MacOw., Bol.

282 —— *Novarum et numis cognitarum stirpium pugillus 1—10, addita enumeratione plantarum omnium in his pugillis descriptarum. Hamburgi, 1828—57.—I.: 1828. 39 pp.—II.: 1830. 30 pp.—III.: 1831. 58 pp.—IV.: 1832. vi., 64 pp. (Hepaticae Wallichianae).—V.: 1833. iv., 28 pp. (Hepaticae).—VI.: 1834. 72 pp., 5 tab. (Cycadeae).—VII.: 1838 (?) 41 pp., 1 tab.—VIII.: 1844. 56 pp.—IX.: 1851. viii., 78 pp. (Potentillae).—X.: 1857. 34 pp. (Hepaticae. Index).

Contains several Cape Cycadeae, Gramineae and Jungermanniae.
Libr. MacOw.

283 —— *De Plantis Cycadeis praesertim Africae Australis. Hamburgi, 1834. 4to. (folio ex Pritzel). 16 pp., 5 tab. col.

In this work 11 species of *Encephalartos* are described. The plates are identical with those in the 6th Pugillus of the work above-named. Some copies have uncoloured plates.
Libr. S. Afr., Fairbr., Bol.

284 Lessing, *Christian Friedrich,* b. 1810, d. 1832. De generibus Cynarocephalarum atque de speciebus generis Arctotidis. Dissert. Berolini, 1832. 8vo. iv., 30 pp.

285 —— *Synopsis generum Compositarum earumque dispositionis novae tentamen, monographiis multarum capensium interjectis. Berolini, 1832. 8vo. xi., 473 pp., 1 tab.

Describes, amongst others, many new Cape species.
Libr. S. Afr., MacOw.

286 L'Heritier (de Brutelle), *Charles Louis,* b. 1746, d. 1800. *Geraniologia, seu *Erodii, Pelargonii, Geranii, Monsoniae* et *Grieli* historia, iconibus illustrata. Parisiis, 1787—88. Fol. max. tit. 44 tab.

A volume of delicately beautiful engravings, mostly by the celebrated Redouté, but without text. Pritzel states that the unpublished manuscript of this work,

and others by the same author, are preserved in the Candollean Library at Geneva. (Priced, 1881, 12*s.*)
Libr. MacOw., Bol.

287 **L'Heritier (de Brutelle)**, *Charles Louis.* *Stirpes novae minus cognitae, quae descriptionibus et iconibus illustravit. Parisiis, typ. D. Pierres. 1784—85. VI. fasciculi. Fol. vi., 184 pp., 84 tab.

Contains figures of about 10 Cape plants.
Libr. MacOw.

288 **Lichtenstein**, *Heinrich*, M.D. *†Travels in South Africa in the years 1803-4-5 and 6. Translated from the original German by Anne Plumptre. London, 1812—15. 2 vols. 4to.—I.: 1812. xii., 383 pp., ind., append.—II.: 1815. xiv., 368 pp., append. (1 and 2), ind.

This traveller was a keen observer of nature, and a good botanist. Remarks on the vegetation of South Africa are scattered through the work. On p. 138 of vol. II. is an interesting account of J. A. Auge, one of the earlier curators of the Dutch E. I. Company's Gardens in Cape Town, and subsequently a collector, from whom Mich. Grubb bought the specimens of plants described by Bergius (Art. 68).
Libr. S. Afr., P.E., G.Rt.

289 **Lindley**, *John*, Prof. Bot. London, b. 1799, d. 1865. *The Genera and Species of Orchidaceous Plants. London, 1830—40. 8vo. xviii., 553 pp. In 7 parts.

Although the number of known Cape orchids has greatly increased since the publication of this work, yet it remains indispensable to the Cape student. With it should be consulted Sonder's Enumeratio (Art. 432), Reichenbach (Art. 398).—Pritzel says there is a larger edition of this work with 40 col. plates drawn by Francis Bauer; but it is not in the library of the Royal Herbarium at Kew, and is probably a mistaken reference to Bauer's Illustrations of Orchidaceous Plants (Art. 59). (Somewhat rare. Sells 50*s.* to 55*s.*)
Libr. S. Afr., MacOw., Bol.

—— Illustrations of Orchidaceous Plants, see **Bauer**, Art. 59.

290 —— *Notes on the Cape Orchidaceae of Drège. In Hooker's Companion to the Botanical Magazine, vol. II. London, 1835—1836. 8vo. pp. 200—210.

Contains full descriptions of over 40 species, mostly of the Vandeae, with a few Ophrydeae, chiefly from Drège's collections. The greater part of this paper is reproduced in Reichenbach fil. "Orchides," in Walper's Ann. Bot. Syst., vol. VI.
Libr. MacOw., MS. transcript.

291 —— *On four new species of Cape Orchidaceae. In Annals of Nat. Hist., vol. IV. London, 1840. p. 314.

292 —— *Notes upon Cape Orchidaceae. In Hooker's Lond. Journ. of Botany, vol. I. London, 1842. 8vo. pp. 14—18.

Contains descriptions of several Cape Orchids, mostly by Harvey.
Libr. S. Afr. (also Bol., MS. transcript).

293 Link, *Heinrich Friedrich,* Prof. Bot. Berlin, b. 176[illegible] d. 1851, and **Otto,** *Friedrich.* Icones plantarum selectarum horti regii botani Berolinensis cum descriptionibus et colendi ratione. Abbildungen auserlesen Gewächse des Königlichen botanischen Gartens zu Berlin. Fasc. I.—X. Berolini, 1820—28. 4to. 128 pp., 60 tab. col.

This series contains plates of 14 Cape species.

294 —— Icones plantarum rariorum horti regii botanici Berolinensis cum descriptionibus et colendi ratione. Abbildungen neuer und seltener Gewächse des Königlichen botanischen Gartens zu Berlin. Pars I. fasc. I.—V. Berolini, 1828(—31). 4to. 96 pp., 48 tab. col.

Includes several Cape plants.

295 Linnaeus, *Carl,* Prof. Bot. Upsal, b. 1707, d. 1778. *Hortus Cliffortianus, plantas exhibens, quas in hortis tam vivis quam siccis Hartecampi in Hollandia, coluit vir nobiliss. et generosiss. Georgius Clifford, J.U.D., reductis varietatibus ad species, speciebus ad genera, generibus ad classes, adjectis locis plantarum natalibus differentiisque specierum. Cum tab. aen. Amstelaedami, 1737. Folio. x., iv., 501 pp. (i.e. pp. 1—231 et 301—501), 1 p. addenda, (16) pp. ind., 36 et 1 tab. (tit. chalcograph.).

Contains many Cape plants, and excellent figures of nine Cape species. (Sells about 12*s.*)
Libr. MacOw.

296 —— *Species plantarum, exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonimis selectis, locis natalibus secundum systema sexuale digestas. Holmiae, impensis Laurentii Salvii. 1753. 2 vols. 8vo. 1200 pp., praef. ind.——*2nd edition, enlarged. Stockholm. 1762—63. *3rd edition, Vienna, 1764. 2 vols. 8vo. 1682 pp., ind. *4th edition, edited by Carl Ludwig Willdenow, Berlin, 1797—1830. 6 vols. 8vo.

A work now out of date. (Sells about 15*s.*)
Libr. MacOw.

297 —— *Systema Vegetabilium, secundum classes, ordines, genera, species, cum characteribus et differentiis. Editio XIII. accessionibus et emendationibus novissimis manu perillustris auctoris scriptis adornata a Johann Andreas Murray. Goettingae, 1774. 8vo. vi., 844 pp.—Supplementum, &c. Brunsvigae, 1781. 8vo. 467 pp., praef.—Ed. XIV., ed. J. A. Murray. Goettingae, 1784. 8vo. xx., 887 pp., ind.—Ed. XV. Parisiis, 1798. 8vo. xvi., 821 pp.—Ed. decima quinta, C. H. Persoon. Goettingae, 1797. 8vo. xvi., 1026 pp., ind.—Ed. nova, Roemer et Schultes, Stuttgardiae, 1817—30. VII. voll. 8vo.—Ed nova J. A. Schulte et J. H. Schultes. Stuttgardiae, 1822—27. III. voll. 8vo.—Ed. XVI., Kurt Sprengel. Goettingae, 1825—28. IV. voll. vel V. partes. 8vo.—Tentamen supplementi, Anton Sprengel. 1828. 35 pp.

The first edition of this work was entitled the 13th, because the vegetable kingdom had already been described in twelve editions of the *Systema Naturae.* The last edition but one of Roemer and Schultes is incomplete, comprising only the classes Monandria to Hexandria, Roemer having died after the publication of the fourth, and Schultes after that of the seventh volume. (Priced variously from 20*s.* to 30*s.*)
Libr. MacOw. (ed. Sprengel).

Dissertationes Academicae.

298 **Linnaeus,** Centuria I. plantarum (Resp. *Abraham D. Valenius*). Upsaliae, 1755. 4to. 35 (5) pp.

According to Thunberg this and the following treat of Cape plants.

299 —— Centuria II. plantarum (Resp. *Eric Torner*). Upsaliae, 1756. 4to. 33 (5) pp.

300 —— Flora Capensis (Resp. *Carl Hendrik Wänmann*). Upsaliae, 1759. 4to. 19 pp.

301 —— Plantae rariores Africanae (Resp. *Jacob Printz*). Upsaliae, 1760. 4to. 28 pp.

302 —— De Erica (Resp. *Johann Adolf Dahlgren*). Upsaliae, 1770. 4to. 15 (5) pp., 1 tab.

303 —— Planta Aphyteja (Resp. *Erik Acharius*). Upsaliae, 1776. 4to. 12 pp., 1 tab.

Treats of *Hydnora africana*, Thunb.

All the foregoing Dissertations reappeared in the following:

304 —— *Amoenitates academicae, seu dissertationes variae, physicae, medicae, botanicae, antehac seorsim editae, nunc collectae et auctae cum tabulis aeneis. Holmiae et Lipsiae, 1749—1779. VII. voll. 8vo.—Ed. III. curante J. C. D. Schreber. Erlangae, 1787—90. X. voll. 8vo.

(Offered by Voigt, Leipzig, 1879, Schreber's ed., at 13 marks.)

305 *"**Linnaea.**" Ein Journal für die Botanik in ihrem ganzen Umfange. Herausgegeben von D. F. L. von Schlechtendal. Vol. I.—VIII. Berlin, 1826—33. 8vo. Vol. IX.—XXXIV. Halle a. d. S. 1834—1867. 8vo.—Neue Folge, vol. I.—VIII. Berlin, 1869—1879. 8vo. Herausgegeben von A. Garcke.

This celebrated Botanical Journal was the first to publish recensions of Ecklon and Zeyher's collections, which formed a large part of the third era of Cape Botany, as Thunberg's labours formed of the second. In this Catalogue it has been thought advisable to give separate references to all the articles useful to the Cape student. (Complete copies offer for about 350 Marks.)
Libr. S. Afr. (vols. 1—11), MacOw. (vols. 1—22), Bol. (complete).

306 **Loddiges,** *Conrad.* *The Botanical Cabinet, consisting of coloured delineations of plants from all countries. London, 1818—24. 10 vols. small 4to. Col. plates 1—1000, as many pages of text, and ind: Vols. XI.—XX. London, 1825—33. 8vo. Col. plates. 1001—2000, as many pages of text, and ind.

This beautiful work contains many showy Cape plants, especially Ericeae, for the cultivation of which Loddiges' nursery-garden at Hackney was celebrated. Only the large paper quarto impression has the plates coloured. The text refers to culture only, and contains no botanical details; it is therefore of less value to the student than the Botanical Magazine or the Botanical Register. (Priced £20 to £22. 10s.)

307 Loudon, *John Claudius*, b. 1783, d. 1843. *An Encyclopaedia of plants; comprising the description, the specific character, culture, history, application in the arts, and every other desirable particular respecting all the plants indigenous to, cultivated in, or introduced into Britain; with figures of nearly 10,000 species; the specific characters by Professor Lindley; the drawings by J. D. C. Sowerby; the engravings by R. Branston. London, 1829. 8vo. xx., 1159 pp., wood-cuts. —— First additional supplement, ib. 1841. 8vo. iv., 1143—1329 pp. —— Ed. II., corrected, with supplement. London, 1841. 8vo. —— New edition ib. 1866. 8vo. (scarcely differs).

This work is a Species Plantarum for amateurs and gardeners. Unfortunately it is constructed upon the Linnaean system, an arrangement which greatly mars its usefulness as a botanical work. (The first edition was published at £4. 14*s*. 6*d*., the supplement 15*s*., 2nd edition £3. 13*s*. 6*d*., last ed. 42*s*.)
Libr. P.E., MacOw.

308 Loudon, *Jane Wells*, Widow of J. C. L., b. 1802, d. 1858. *The Ladies' Flower Garden of Ornamental Bulbous Plants. London, 1841. 4to. x., 270 pp., 58 col. plates.

The plates, representing 305 species, give the external facies of many Cape Monocotyledons. (Pub. £2. 12*s*. Sells 35*s*. to 40*s*.)
Libr. Bol.

309 Ludwig, Baron *C. F. H. von.* *List of Exotic Trees, Shrubs, Plants, Bulbs, Seeds, &c. imported lately from Germany, Holland, &c. (into the Cape Colony). In the S. A. Quarterly Journal, vol. II. Cape Town, (No. 1, Oct. 1831). 8vo. pp. 40—45.

Only of interest as recording the name of Ludwig, the possessor of a fine garden in Cape Town, and for many years a liberal and intelligent patron of Botany in the Colony.
Libr. Bol.

Cryptogamic Botany.

310 Lehmann, *J. G. C.* (see above). *Hepaticarum Capensium a C. F. Ecklon collectarum, brevem recensionem cum Schlechtendahlio suo communicavit J. G. C. Lehmann. In Linnaea, vol. IV. Berlin, 1829. 8vo. pp. 357—371.

Contains brief diagnoses of 52 Cape Hepaticae.
Libr. S. Afr., Bol.

311 Leighton, Rev. *William Allport.* On the Lichens of St Helena. London, 4to. 1 col. plate.

312 Lindenberg, *Johann Bernhard Wilhelm*, d. 1851. *Hepaticarum Capensium a C. F. Ecklon collectarum brevis recensio. In Linnaea, vol. IV. Berlin, 1829. 8vo. pp. 357—371.

Libr. S. Afr., MacOw., Bol.

See also Art. 176, under **Gottsche.**

313 Lorentz, *Paul Günther*, Prof. Bot. Cordova (S. America). b. 1835, d. 1881. Moosstudien. Leipzig, 1864. 4to. viii., 172 pp., 5 tab.

The Pugillus Specierum Nov. Exoticarum in this work contains 2 Cape species.

M

Phanerogamic Botany.

314 MacGibbon, *James,* Formerly Curator Bot. Gard. Cape Town. *Catalogue of Plants in the Botanic Gardens, Cape Town, Cape of Good Hope. Cape Town, 1858. 8vo. iv., 36 pp.

Libr. MacOw.

315 McNab, *William,* Curator Bot. Gard. Edinburgh, b. 1780, d. 1848. A treatise on the propagation, cultivation and general treatment of Cape heaths, in a climate where they require protection during the winter months. Edinburgh, 1832. 8vo. 43 pp., 1 col. plate.

316 MacOwan, *Peter,* Director Bot. Gard. Cape Town. *†Catalogue of South African Plants compiled for the use of the S. A. Botanical Society, and adapted for marking desiderata in exchanges of specimens. Grahamstown, 1866. 8vo. 31 pp.

Contains a transcript of the generic and specific names of the plants contained in the first 3 vols. of Harvey and Sonders' Flora Capensis, with a few additions.

Libr. MacOw., Bol.

317 —— *Notulae Capenses. In Journal of the Linnean Society, vol. x. London, 1867. 8vo. pp. 480—482.

Describes 3 species of *Senecio.*

Libr. MacOw., Bol.

318 —— *Addenda supplementary to Harvey's "Genera of South African Plants." In Cape Monthly Magazine, vol. III. N.S. Cape Town, Nov. 1871.

Supplies some omissions in the 2nd edition of that work, and an additional genus.

Libr. MacOw., Bol.

319 —— *†Herbarium Notes for the use of Students of Cape Botany. Privately printed. Lovedale (Cape Colony), 1871. 12mo. 17 pp.

Libr. MacOw., Bol.

320 —— *Colonial Stock Food-Plants. In Cape Monthly Magazine, vol. xv. Cape Town, Aug. 1877. 8vo. pp. 83—92.

A report presented to the Government Commission on Deterioration and Diseases in cattle, pointing out the chief indigenous plants useful as cattle food.

Libr. MacOw., Bol.

321 —— *Botanical Ways and Means. In Cape Monthly Magazine, vol. xvi. Cape Town, March, 1878. 8vo. pp. 144—155.

A reprint with additions and alterations of Art. 319, and containing merely details of botanical manipulation.

Libr. MacOw., Bol.

322 MacOwan, *Peter* and *H.* **Bolus.** *Novitates Capenses. Descriptions of New Plants from the Cape of Good Hope. In Journal of Linnean Soc. (Botany), vol. xviii. London, 1881. 8vo. pp. 390—397.

Describes 11 new species.

Libr. MacOw., Bol.

323 Masson, *Francis*, b. 1741, d. 1805. **Stapeliae* Novae; or, a collection of several new species of that genus, discovered in the interior parts of Africa. London, 1796. Small folio. 24 pp., 41 col. plates.

The author was a collector for the Royal Gardens, Kew; and was at the Cape in 1772, at the same time as Thunberg, Lady Ann Monson and Oldenburg. The plates represent the facies of the plants with considerable fidelity but no dissections are given, an omission which renders difficult the determination of some critical species. (Sells about 42*s*.)
Libr. S. Afr., MacOw., Bol.

324 Masters, *Maxwell Tylden*, M.D. *Observations on the Morphology and Anatomy of the Genus *Restio*, together with an enumeration of the South African species. In Journal of the Linnean Society, vol. VIII. London, 1865. 8vo. pp. 211—255, 2 plates.

Now absorbed in the author's monograph of the order, see Art. 124.
Libr. MacOw., Bol.

325 —— *Synopsis of the South African Restiaceae. In Journal of the Linnean Society, vol. X. London, 1867. 8vo. pp. 209—279, 2 plates.

Describes the genera of the order other than *Restio*.
Libr. MacOw., Bol.

326 —— *On the Restiaceae of Thunberg's Herbarium. In Journ. Linn. Soc., vol. XIV. Lond. 1875. 8vo. pp. 413—421.
Libr. Bol.

327 —— *On the Dimorphism of Restiaceae. In Trimen's Journ. of Bot., vol. VII. N.S. London, 1878. 8vo. pp. 36—37, with plate (194 fig. 2).
Libr. MacOw., Bol.

*** This writer is also the author of the Monograph of Restiaceae, in "Monographiae Phanerogamarum, &c." of A. and C. De Candolle. See Art. 124.

328 Medicus, *Friedrich Casimir*, Director of Gardens, Schwetzingen and Mannheim, b. 1736, d. 1808. **Theodora speciosa*, ein neues Pflanzengeschlecht; nebst einem Entwurfe, die künstliche und natürliche Methode in Ordnung des Pflanzenreiches zugleich anzuwenden. Mannheim, 1786. 8vo. 116 pp., 4 tab.

Contains description and figure of *Aloe plicatilis*, Mill, and of *Schotia* (*Theodora*) *speciosa*, Jacq. The latter handsome Cape plant was published in the Collectanea at Vienna in the same year, but was first described by Boerhaave in 1720 (Index alter, Art. 71), and subsequently by several other authors. (Pub. ⅓ Thaler.)
Libr. MacOw.

329 Meerburg, *Nicolaas*. Plantarum selectarum icones pictae. Lugduni Batavorum, 1798. Folio (10) pp. 28 tab. col.

Contains figures of Cape plants; these are, however, characterised by Alph. De Candolle (Prodr. XIV. p. 484) as "icones undique pessimae."
Libr. MacOw.

330 **Meisner,** *Karl Friedrich* (afterwards **Meissner**), Prof. Bot. Basle, b. 1836, d. 1874. *Synopsis Thymelearum, Polygonearum, et Begoniarum Africae Australis, imprimis a cl. J. F. Drège lectarum. In Linnaea, vol. XIV. Halle a. d. S. 1840. 8vo. pp. 385—502.

Libr. MacOw., Bol.

331 —— *Contributions towards a Flora of South Africa. In Hooker's Lond. Journ. of Bot., vol. I. Lond. 1842. 8vo. pp. 459—476. Vol. II. ib. 1843. pp. 53—105, and 527—559.

Descriptions of Cape and Natal plants, chiefly of Krauss's collections in 1838—9.

Libr. S. Afr., Bol.

*** This author elaborated in De Candolle's Prodromus the orders Polygonaceae, Proteaceae, Thymeleaceae, Lauraceae and Hernandaceae.

332 **Mentzel,** *Christian*, b. 1622, d. 1701. Lexicon plantarum polyglotton universale, &c. Berol. 1696. Folio. 331 pp. (18) foll., 11 tab.

This is a re-impression of an earlier work dated 1682, and bearing the title "Index nominum plantarum, &c." We quote it here because Pritzel mentions that to this edition was added "Ad indicem universalem nominum plantarum et pugillum corollarium," 2 pages, and plates 12—13, in which the plants collected by Johann Friedrich Ruecker, at the Cape of Good Hope, were described, with figures of some. (Ed. 1682, priced, Friedländer, 3s.)

333 **Meyer,** *Ernst Heinrich Friedrich*, Prof. Bot. Königsberg, b. 1791, d. 1858. *Commentariorum de plantis Africae Australioris, quas per octo annos collegit observationibusque manuscriptis illustravit Joannes Franciscus Drège, vol. I. fasc. 1 et 2. Lipsiae, 1835—37. 8vo. lxx., 326 pp.

The preface to this work is a very valuable contribution to Cape phyto-geography. See Drège, Art. 149. For the true date of publication of the 1st fasc. see Art. 535.

Libr. S. Afr., MacOw., Bol.

334 —— *De *Hydnora*. In Nov. Act. Acad. Leop. Car. Bonn, 1833. 4to. Vol. XVI. II. p. 479.

This memoir contains 2 beautifully executed plates of *H. africana* and *H. triceps*. Compare Sir J. D. Hooker on *Hydnora americana*, R. Br. in Linn. Soc. Journal, vol. XIV., pp. 182—188, especially with reference to the geographical distribution of this extraordinary genus.

Libr. MacOw.

*** This author was the writer of the "Einleitung," or Introduction to the "Zwei Pflanzengeographische Documente" of Drège (Art. 149), an essay of great value upon the Cape Flora, and its relations with those of other countries. A translation, by one of the compilers of this Catalogue, was published in the Cape Monthly Magazine, vols. VII. and VIII. Cape Town, 1873—74.

335 —— *Plantae Ecklonianae. Leguminosae. In Linnaea, vol. VII. Berlin, 1832. 8vo. pp. 145—173.

Libr. S. Afr., MacOw., Bol.

336 **Miers,** *John*, b. 1789, d. 1879. *Illustrations of South American plants, vols. I., II. London, 1846—57. 4to. 87 plates.

Vol. II. p. 94 et seq. contains incidentally a revision of the Cape species of *Lycium*, with figures of 8 species. The Cape student, however, will find a sufficient abstract in Walper's Annales Bot. Syst., vol. V., pp. 577—78.

337 Miquel, *Friedrich Anton Wilhelm*, Prof. Bot. Utrecht, b. 1811, d. 1871. Monographia Cycadearum. Trajecti ad Rhenum, 1842. Folio. 82 pp., 8 tab.

(Pub. 4½ Th.; offered 1½ Th.) For figures of several species of *Encephalartos* compare Linnaea, XVII. pp. 675—744, and vol. XIX. pp. 411—430, tab. 1—7. (Priced, Friedländer, 7 marks.)
Libr. MacOw.

338 —— *De *Cycadeis* Loddigesianis. Epistola ad vir. cl. G. H. de Vriese, quam scripsit F. A. G. Miquel. 8vo. pp. 1—7. [No title-page or imprint.]

This letter is dated November, 1842.
Libr. Bol., MacOw.

339 —— *Prodromus Monographiae *Ficuum*. In Hooker's London Journal of Botany, vol. VI. London, 1847. 8vo. pp. 514—538, plates xxi.—xxiii. Vol. VII. ib. 1848. pp. 64—78, 109—116, 221—236, 425—442, 451—491.

This monograph, so far as regards Cape species, is merged in the succeeding work, Art. 341.
Libr. S. Afr., Bol.

340 —— *De *Encephalarto horrido* Lehm. ejusque formis. In Tydschr. voor Natuurl. Gesch., deel VI. 8vo. 12 pp., 2 tab.
Libr. MacOw.

341 —— *Over de Afrikaansche Vyge boomen. Amsterdam, 1849. 4to. 40 pp., 5 tab.

This memoir, which is in Dutch, gives preliminary details of the distribution of the genera *Ficus*, *Sycomorus*, and *Urostigma*, enumerates 53 species and figures 14; one of which is the large-leaved *U. abutilifolium*, Miq., from Magaliesberg. Only 6 species belong to South Africa. Compare Drège in Linnaea, vol. XX. (1847) p. 214; and Walpers' Ann. Bot. Syst. I. p. 706. III. p. 417.—(Priced, Friedländer, Mk 2. 50.)
Libr. MacOw., Bol.

342 —— *Prodromus Systematis Cycadearum. Ultrajecta et Amstelodami, 1861. 4to. ii., 36 pp.

A catalogue of fossil as well as a description of living species. (Priced, Friedländer, 1 Mark 50.)
Libr. S. Afr., Bol.

343 Mohl, *Hugo von.*, Prof. and Direct. Bot. Gard. Tuebingen, b. 1805, d. 1872. *Untersuchungen ueber den Mittelstock von *Tamus Elephantipes*, L. Tübingen, 1836. 4to. 16 pp.

An inaugural dissertation of considerable physiological interest. Appears also in Vermischte Schriften (see next page), pp. 186—194.
Libr. MacOw.

344 Mohl, *Hugo von.* *Vermischte Schriften. Tuebingen, 1845. 4to. viii., 442 pp., 12 tab.

Contains *inter alia* a memoir, "Ueber die Spaltöffnungen auf den Blättern der Proteaceen," pp. 245—251.

345 Monteiro, *Joachim John*, African traveller, d. Mozambique, 1878. *Angola and the River Congo. 2 vols., with maps and illustrations. London, 1875. 8vo.

Although the region here treated of lies beyond the limits of our work, we quote this book on account of the excellent figure and description of the remarkable *Welwitschia mirabilis*, Hook. f.

346 Moore, *Spencer Le Marchant.* *Alabastra Diversa. In Trimen's London Journ. of Bot., vol. VII. N.S. London, 1878. 8vo. pp. 131—133.

Describes 3 new S. African species.
Libr. S. Afr., MacOw., Bol.

347 Morison, *Robert*, Prof. Bot. Oxford, b. 1620, d. 1683. Plantarum historiae universalis Oxoniensis Pars Secunda, seu Herbarum distributio nova, per tabulas cognationis et affinitatis ex libro naturae observata et detectu. Oxonii, e theatro Scheldoniano, 1680. Folio. 617 pp., 8, 25, 25, 31, 29=118 tab. —— *Plant. hist. univ. Oxoniensis Pars tertia, post auctoris mortem [†1683] expleta et absoluta a Jacobo Bobartio. Cum vita Morisonii. Oxonii, e theatro Sheldoniano, 1699. Folio. 657 pp., ind., 15, 37, 18, 22, 3, 31, 18, 7, 5, 10=166 tab.

Contains figures of Cape plants quoted by De Candolle (Plantes Grasses). We have not seen it. There is another edition publ. London 1715 in 3 parts, including a previous work, "Plantarum Umbelliferarum distributio nova." Linnaeus, in Hort. Cliffort., speaks of the work of 1699 as "opus incomparabile." (Offered, ed. 1715, at 14*s*.)

348 Munting, *Abraham*, Prof. Bot. Gröningen, b. 1626, d. 1683. Aloidarum sive Aloes mucronato folio americanae majoris aliarumque ejusdem speciei historia, in qua floridi illius temporis, lecti, naturae, culturae, nec non qualitatum ratio paucis enarratur. Amstelodami, 1680. 4to. 33 pp., ind., 8 tab.

For the character of this book see Salm Dyck, quoted in Syst. Veg. (ed. Roemer et Schultes, vol. VII. pt. 2, p. 1714) "pessimum opusculum quod unquam comparuit."

Cryptogamic Botany.

349 [MacKen, *Mark J.*, Curator Bot. Gard. Natal.] The Ferns of Natal. Pietermaritzburg, 1869. 8vo. iv., 28 pp.

See also Art. 175, Gerrard.

350 —— *Note upon the occurrence of a new *Puccinia* upon *Mesembryanthemum micranthum*, Haw. In Trans. of the South African Philosophical Society, vol. II. Cambridge—printed for the Society. 1881. 8vo. pp. 89—90.

Libr. Fairbr., MacOw., Bol.

351 Massalongo, *Abramo Bartolommeo*, Prof. Verona, b. 1824, d. 1860. *Lichenes Capenses, quos collegit in itinere 1857—58 Dr Wawra. Venezia, 1861. 4to. 60 pp., 8 tab. col.

Reprinted from vol. x. of the "Memorie dell' Istituto Ven. di Scienze lett. et arti. The preface treats of the distribution of Lichens in Africa and neighbouring countries. Besides 48 species collected by Wawra, an appendix contains descriptions of 18 from other sources.
Libr. MacOw., Bol.

352 Mitten, *William.* *List of Hepaticae collected by the Rev. A. E. Eaton at the Cape of Good Hope (Aug. and Sept. 1874). In Journ of the Linnean Soc., vol. XVI. London, 1877. pp. 187—196. 2 plates.

In this list 38 species are enumerated, of which 5 are described and figured as new.
Libr. Bol.

353 Montagne, *Jean François Camille,* b. 1784, d. 1866. *Enumeratio Fungorum quos a cl. Drège in Africa meridionali collectos et in Herbario Miqueliano servatos, descriptionibus observationibusque nonnullis illustravit C. Montagne, D.M. In Annales des Sc. Nat., vol. VII. Paris, 1847. 8vo. pp. 166—181.

Contains an enumeration of 39 Cape species of Fungi, with diagnoses of several. Appended to these are descriptions of a Lichen, and a supposed new Alga.
Libr. MacOw.

354 —— *Sylloge generum specierumque cryptogamarum quas in variis operibus descriptas iconibusque illustratas, nunc ad diagnosim reductas, multasque novas interjectas, ordine systematico disposuit. Parisiis, 1856. 8vo. xxiv., 498 pp.

A convenient resumé of Montagne's extensive and scattered labours in cryptogamic botany. There are not many Cape species described.
Libr. MacOw.

355 Moore, *Thomas,* Curator Bot. Gardens, Chelsea. *List of Mr Plant's Natal Ferns. In Hooker's Journ. Bot. and Kew Garden Misc., vol. v. London, 1853. 8vo. pp. 225—229.

Contains the first account of *Stangeria paradoxa*, Moore. Compare Art. 383 Plant, and Art. 428 Smith.
Libr. S. Afr.

356 Mueller, *Carl,* b. 1817, d. 1870. *De Muscis Frondosis nonnullis novis vel minus cognitis. In Linnaea, vol. XVII. Halle, 1843. 8vo. pp. 581—601.

Includes several Ecklonian species.
Libr. MacOw., Bol.

357 —— *†Synopsis Muscorum omnium hucusque cognitorum. 2 voll. Berolini, 1849—51. 8vo.—Vol. I.: viii., 812 pp.—Vol. II.: 772 pp. Accedit Index synonymorum Dillenii.

The only work which will systematically assist the Cape student of bryology. (Priced 13 marks.)
Libr. MacOw.

358 —— "Additamenta ad Synopsin," tum "Supplementa Nova." In Botanische Zeitung. Leipzig, 1845—79. 4to.

Many Cape species are described in this serial by way of supplement to the Synopsis above noted. The vol. for 1845 contains 1 sp.; 1847, 2; 1855, 12; 1856, 7; 1857, 2; 1858, 15; 1859, 16; 1862, 2; 1864, 1; 1872, 1. Total, 59 species. We have not seen these, and are not sure whether the above titles are all under which these papers have appeared.

N

Phanerogamic Botany.

359 **Nees von Esenbeck,** *Christian Gottfried,* Prof. Bot. Breslau, b. 1776, d. 1858. *Beitrag zur Kenntniss der Familien der Restiaceen in Rücksicht auf Gattungen und Arten. In Linnaea, vol. v. Berol. 1830. pp. 627—666.

Libr. S. Afr., MacOw., Bol.

360 —— *Plantae Ecklonianae. Gramineae. In Linnaea, vol. VII. Berol. 1832. pp. 273—356.

Pages 339—356 contain a comparison of Thunberg's Gramineae as described in Schultes' edition of his Flora, with Ecklon's collection, and also some remarks upon the ratio in which various tribes of Gramineae appear at the Cape.
Libr. A.E.G.

361 —— *Cyperaceae Capenses Ecklonianae. In Linnaea, vol. VII. Berol. 1832. pp. 491—537.

Libr. S. Afr., MacOw., Bol.

362 —— *Nachtrag zu der Abhandlung ueber die Familie der Restiaceen. In Linnaea, vol. VII. Berol. 1832. pp. 614—619.

Libr. S. Afr., MacOw., Bol.

363 —— *Ueber Schrader's Analecta, verglichen mit N. von E. Erlauterungen der Capschen Cyperaceen in Herrn Ecklon's Sammlung. In Linnaea, vol. VIII. Berol. 1833. pp. 75—94. c., fig. 2, tab. III.

Libr. S. Afr., MacOw., Bol.

364 —— *Cyperaceae Capenses secundum novissimas Ecklonii collectiones. In Linnaea, vol. X. Berol. 1836. pp. 128—207.

Libr. S. Afr., MacOw., Bol.

365 —— *Acanthaceae Africae australioris ab Ecklonis collectae, adjectis nonnullis Dregeanis. In Linnaea, vol. XV. Halle, 1841. 8vo. pp. 351—76.

Libr. MacOw., Bol.

366 —— *Florae Africae australioris illustrationes monographicae. I. Gramineae. Glogaviae, 1841. 8vo. lxx., 491.

There is another impression of this work (not mentioned in Pritzel) bearing the title "Agrostographia Capensis," and the imprint "Halae 1841." On the back of the wrapper is "Agrostographia Capensis Den. Impr." But it is struck off from the same types, and except in being printed upon thicker paper, and in the change of title, does not differ. At present this is the only work upon the species of South African grasses. (For the genera of S. A. Gramineae compare Munro, in Harvey's Genera of S. A. Plants, 2nd ed. Art. 178.) The tables appended to the work are by Dr C. T. Beilschmid, author of several treatises on phyto-geography. (Pub. 2 Th. Sells 6s.)
Libr. S. Afr., MacOw., Bol.

Cryptogamic Botany.

367 Naumann, *F.* Bericht ueber die bot. Sammlungen und Beobachtungen welch auf der Reise S.M.S. Gazelle gemacht worden sind. In Verhandl. des Bot. Vereins, für die Mark Brandenburg, vol. XVIII. Berlin, 1876.

A catalogue of mosses collected in the Island of Ascension by Naumann, and determined by Dr Carl Mueller of Halle. Eleven are new.

368 —— Note on Vascular Cryptogams collected during the voyage of S.M.S. Gazelle. In letter to Dr Prahl communicated to the Verhandl. Bot. Vereins f. Brandenburg, vol. XVIII. pp. 26—38.

Report of 7 Filicineae and 2 Lycopodiaceae on Ascension Island.

Nees von Esenbeck [De Hepaticis], see Art. 176, **Gottsche.**

369 —— *Sylloge observationum botanicarum. In Horae physicae Berolinenses, &c. Bonnae, 1820. Folio. xii., 123 pp., 27 tab.

This, the fifth of several memoirs published jointly with other authors, contains descriptions of two Cape Hepaticae, and of *Chareſeis heterophylla D. C.* (sub synon.) with a beautiful coloured plate. The same work contains a memoir on mosses, partly Cape, by Hornschuch, see Art. 333. (Sells 12*s.* to 15*s.*)
Libr. MacOw., Bol.

370 Nylander, *Wilhelm,* Prof. Bot. Helsingfors, b. 1823. *Synopsis methodica Lichenum omnium hucusque cognitorum, praemissa introductione lingua gallica tractata, tomus I. [all published]. Parisiis, 1858—59. 430, iv. pp., 8 tab. col.

Contains an elaborate introduction to the study of Lichens, in French, preceding the synopsis of genera and species in Latin. The work proceeds to the end of genus *Phyſia*, including many belonging to the Cape. The plates are singularly beautiful. (Pub. 20 fr.)
Libr. MacOw.

371 —— Note sur les Lichens de Port-Natal. Caen, 1868. 8vo.

372 —— Liste des Lichens recueillés par M. G. de l'Isle aux îles St Paul et Amsterdam et descriptions des espèces nouvelles. In Comptes Rendus de l'Acad. Française. Paris, Oct. 1875. pp. 725—26., tab. 81.

Thirteen species, of which 10 are new, belong to the former, 2 only to the latter island.

O

Phanerogamic Botany.

373 Oliver, *Daniel,* Curator Roy. Herb. Kew. *Memorandum on the genus *Thamnea*, Sol. and other Bruniaceae contained in the South African Herbarium of the late Dr Burchell. In Journ. of Linn. Soc., vol. IX. London, 1867. 8vo. pp. 331—333.

Describes several new species of this little-known group. They are figured in the Icones Plantarum (Art. 217), vol. XI. pl. 1012, 1013.
Libr. Bol.

374. Oliver, *Daniel.* *On the Lentibularieae collected in Angola by Dr Welwitsch, A.L.S., with an enumeration of the African species. Journal of Linn. Soc., vol. IX. London, 1867. 8vo. pp. 144—156.

Enumerates 9 South African species.
Libr. Bol.

375 Olearius, *Johan Christoph,* b. 1668, d. 1747. Aloedarium historicum, i.e. Historische Beschreibung derjenigen Aloen, &c. Arnstadt, 1713. 8vo. 48 pp., praef., 2 tab.

P

Phanerogamic Botany.

376 Pappe, *Carl Wilhelm Ludwig,* Colonial Botanist, Cape of Good Hope, b. 1803, d. (Cape Town) 1862. *A list of South African indigenous plants used as remedies by the colonists of the Cape of Good Hope. Cape Town, 1847. 8vo. 14 pp.

Libr. MacOw.

377 —— *Florae Capensis Medicae Prodromus; or, an enumeration of South African indigenous plants used as remedies by the colonists of the Cape of Good Hope. Cape Town, 1850. 8vo. vii., 32 pp., ind. —— Second edition, with corrections and numerous additions. Cape Town, 1857. 8vo. vi., 54 pp. —— Third edition. ib. 1868 [does not differ].

Libr. S. Afr., MacOw., Bol.

378 —— *Silva Capensis, or a description of South African forest trees, and arborescent shrubs used for technical and economical purposes by the colonists of the Cape of Good Hope. Cape Town, 1854. 8vo. 53 pp. —— Second edition, "revised and enlarged." London and Cape Town, 1862. 8vo. Praef., 43 pp. Appendix I., on *Myrica cordifolia*, Linn., pp. 44—47. Appendix II., "Contributions to the South African economic Flora." pp. 48—55. Glossary. Index.

Libr. S. Afr., MacOw., Bol.

379 —— *†Botanical Geography and Distribution of S. A. Planta. In Cape Monthly Magazine, vol. VIII. Cape Town (Oct.), 1860. pp. 237—249.

Partly reprinted in Noble's Official Handbook—The Cape and South Africa.

380 Penzig, Dr *Otto.* *Die Dornen von *Arduina ferox* E. Mey. Regensburg, 1879. 8vo. 7 pp., with plate. (Separat-Abdruck aus Flora, 1879, No. 22.)

Libr. Bol.

381 Pereira, *Jonathan,* b. 1804, d. 1853. *The elements of Materia medica and Therapeutics. Fourth edition. 2 vols. London. 1854—57.

Contains a full account of the officinal Cape Aloes and Buchu (*Barosma crenulata*, Hook.).

382 Petiver, *James*, d. 1715. Gazophylacii naturae et artis decades x. in quibus animalia, quadrupedes, aves, pisces, reptilia, insecta vegetabilia, item fossilia, corpora marina et stirpes minerales e terrâ erutas lapides figurâ insignes descrip. brevibus et icon. illustrantur. Londini, 1702–1709. II. voll.—I.: Decas 1—5. 1702—1704. 78 pp. in 8vo., tab. in folio 1—50. A classical and topical catalogue of all the things figured in the 5 decades, or first volume of the Gazophylacium naturae et artis. 1706—8. pp. 81—94.—II.: Decas VI.—X. 1709. Folio. 12 pp., tab. 51—100 (cont. 1218 fig.).

Contains many figures of Cape plants. Pritzel. (Priced by Friedländer, 36 mk.)

383 Plant, *R. W.* *Notice of an Excursion to the Zulu Country. In Hooker's Journal of Botany and Kew Garden Miscellany., vol. iv. London, 1852. 8vo. pp. 257—265.

The writer, who went to Natal as a collector in 1850, gives a brief and general account of the vegetation of the country.
Libr. S. Afr.

384 Plukenet, *Leonard*, b. 1642, d. 1706. *Opera omnia botanica, in sex tomos divisa. Londini, 1720. 6 voll. 4to.

I.: Phytographia, &c. 1691. Tab. 1—120 (C. effig. auct.).
II.: Phytographia. 1692. Tab. 121—250.
III.: Phytographia. 1696. Tab. 251—328.
IV.: Almagestum botanicum, &c. 1696. 402 pp.
V.: Almagesti botanici Mantissa, &c. 1700. 191 pp., ind., tab. 329—350.
VI.: Amaltheum botanicum, &c. 1705. 214 pp. Tab. 351—454.

There is another edition of this work in four vols., pub. Lond., 1769, *4to.*, with a portrait of the author in the first volume. Contains figures of Cape plants, but is a work of more pretension than value. The figures are fragmentary and variable in scale, and the inflorescence often very carelessly indicated. (Sells for about 30s.) For more recent nomenclature of the plants described by Plukenet, see Indexes, under the heads of **Giseke** (Art. 171) and **Tenzel** (Art. 447).
Libr. MacOw.

385 Presl, *Karel Boriwog*, Prof. Nat. Hist. Prague, b. 1794, d. 1852. *Prodromus monographiae Lobeliacearum. Pragae, 1836. 8vo. 52 pp.

A reprint from the transactions of the "Koenigl. Boehm. Gesellsch. der Wissensch." Now absorbed in Sonder's Revision in Flor. Cap., vol. II.
Libr. MacOw.

386 —— *Botanische Bemerkungen. Prag, 1844. 4to. 154 pp.

Reprinted from the Trans. of the "Koenig. boehm. Gesell. d. Wiss.," vol. III. Contains descriptions and references to a considerable number of Cape plants, chiefly from the collections of Drège, Ecklon and Zeyher. In the preface the author, referring to the disputed priority of the Enumeratio of Ecklon and Zeyher, and the Commentaries of Meyer, takes the opposite view to that assumed by the author of the "Animadversiones Criticae." He says: "Walpers, in seinem 'Animadversiones,' et später in seinem 'Repertorium' von einem falschen Gesicht-punkte ausging."—*Non nostrum est tantas componere lites!*
Libr. S. Afr., MacOw.

387 Pritchard, *Stephen F.* An alphabetical list of indigenous and exotic plants, growing on the island of St Helena, corrected by Mr James Bowie, botanist, Ludwigsburg garden. Cape Town, 1836. 8vo. 31 pp.

We have not seen this. A note in Kuhn's Filices Deckenianae states that it

includes 31 indigenous phanerogams and 21 ferns. It is stated in the Linnaea (XII. p. 237) to be a mere list without even the citation of the authority for the names, and is characterised as "sehr unvollstandig und kaum benutzt."—There is an anonymous catalogue recorded by Pritzel under the title "Flora Sta Helenica. St Helena, printed by J. Boyd. 1825. 4to. 20 pp.," which we have not seen; compare Art. 539.

388 Pritzel, *Georg August,* Libr. Acad. Sci. Berlin, b. 1815, . 1874. *Thesaurus Literaturae botanicae omnium gentium inde a rerum otanicarum initiis ad nostra usque tempora quindecim millia opera recens. ipsiae, 1851. 4to. viii., 547 pp.—Ed. II. "editionem novam reformatam." ipsiae, 1872—7. 4to. Praef., 576 pp., epilog.

Although the title-page of the 2nd ed. bears the date 1872, the second part was not published until 1877, having been edited by Prof. D. Jessen after Pritzel's death.—A work indispensable to the student, and to which we here record our great obligations in preparing this catalogue. (First ed. sells 15*s.*; 2nd ed. pub. 44 marks.)
Libr. S. Afr. (1st ed.), MacOw., Bol. (2nd ed.).

389 —— *Iconum Botanicarum Index locupletissimus, &c. Berlin, 1855. 4to. xxii., 1184 pp.—Ed. novis titulis ab auctore repudiata. ib. 1861.—*Zweiter bis zum Jahre 1865 fortgeführter Theil. ib. 1866. 4to. ii., 298 pp.

A valuable list of botanical figures scattered through numerous works, still, however, by no means complete.—In the Library of the Herbarium of the Royal Gardens, Kew, is a voluminous MS. catalogue of figures of plants which, founded on Pritzel, is kept daily posted, and is of inestimable value to the student.
Libr. MacOw., Bol.

Cryptogamic Botany.

390 Pappe, *C. W. L.* and **Rawson,** *R. W.* *Synopsis Filicum Africae Australis; or, an enumeration of the South African Ferns hitherto known. Cape Town, 1858. 8vo. viii., 57 pp.

Mr Rawson was Colonial Secretary of the Colony. The descriptions are scarcely to be commended, and the book is now quite out of date and requires much revision.
Libr. S. Afr., P.E., Gr. Bt., MacOw., Fairbr., Bol.

391 Petit, *P.* *Diatomées de Table Bay (Cap de Bonne Espérance). Paris, 1876. 8vo. 8 pp., av. pl.

A reprint from a French periodical entitled "Les Fonds de la Mer," tom. II.; livr. 16, p. 252. (Sells 2*s.*)
Libr. MacOw., Bol.

R

Phanerogamic Botany.

392 Rach, *Louis.* *Die Ericaceen der Thunberg'schen Sammlung, verglichen mit denen des Koeniglichen Herbariums zu Schoeneberg bei Berlin. In Linnaea, vol. XXVI. Halle, 1853. 8vo. pp. 767—793.

Amongst the collations are descriptions of 3 new species from Thunberg's Herbarium.
Libr. Bol.

393 Redouté, *Pierre Joseph*, b. 1761, d. 1840. *Les Liliacées peintes par P. J. Redouté. Paris, 1802—16. 8 vols. fo. 486 foll., ind., 4[illegible] tab. col.

The text of the first four volumes was written by A. P. de Candolle; of vols. 5 and 6 by François de la Roche; of vols. 7 and 8 by Alire Raffenau Delile. The work contains many figures of Cape Iridaceae, as well as Liliaceae. (Somewhat rare; we have not seen any copy recently offering.)
Libr. S. Afr.

394 Regel, *Eduard*, Direct. Bot. Gard. Petersburg. Die Kultur und Aufzaehlung der in deutschen und englischen Gaerten befindlichen Eriken, nebst Synonymie und Kurzer Charakterisirung und Beschreibung derselben. (Zurich, 1843.) 4to. 189 pp., 3 tab.

There seems to have been a subsequent edition printed at Berlin in 1850. (Priced 6 marks.)
Libr. MacOw.

395 —— *Cycadearum generum et specierum revisio. Petersburg, 1876. 8vo. 48 pp.

A reprint from the Acta Horti Petropolitani, being Fasc. IV. of "Descriptiones plantarum novarum et minus cognitarum." In Fasc. II. of the same series is a description of *Encephalartos Verschaffeltii*, Reg. and a brief conspectus of the other species of this Cape genus. (Priced 1 mark 50 pf.)
Libr. MacOw., Bol.

396 Rehman, *Anton*, Prof. Geogr. Lemberg. *†Geo-Botaniczne Stosunki Poludniowej Afryki. Krakow, 1879. 4to. 69 pp., 3 tab. lith. [The Phytogeographical Conditions of South Africa.]

It is to be regretted that the author, a recent botanical traveller and collector in the Cape Colony and the Transvaal, should have written in a language understood by so few European students. An abstract of the paper by the author, in German, will be found in the Botanisches Centralblatt. Leipzig, 1880. 8vo. pp. 1119—1128.
Libr. Bol.

397 Reichenbach, *Heinrich Gottlieb Ludwig*, Prof. Bot. Dresden, b. 1793, d. 1879. *Magazin der aesthetischen Botanik, oder Abbildung und Beschreibung der für Gartenkultur empfehlenswerthen Gewächse, nebst Augabe ihrer Erziehung. Icones et descriptiones plantarum, &c. Leipzig, 1822—26. 4to. XXVIII. pp., 96 tab. col. (with corresponding text, pages not numbered).

The plates include 50 Cape species, chiefly Byttneriaceae (see Linnaea, I. p. 281), but these are not quoted by Harvey, Flor. Cap., vol. I. (Publ. 16 Thaler.)
Libr. Bol.

398 Reichenbach, *Heinrich Gustav* filius, Prof. Bot. Hamburg. *Orchidiographische Beitraege. In Linnaea, vol. XIX. Halle, 1847. 8vo. pp. 369—379. Vol. XX. Id. 1847. pp. 673—696.—Vol. XLI. Berlin, 1877. p. 55. (*Disperis purpurata*, Reichb. f.)

Many new Cape species are described in these papers, chiefly from the collections of Gueinzius and Mundt.
Libr. MacOw., Bol.

a. —— Otia botanica Hamburgensia. Hamburgi, 1878—81. 4to. Fasc. I. 1878, pp. 68; fasc. II. pars 1ma, 1881. pp. 73—120.

At pages 95—119 under the heading "Novitiae Africanae" are contained descriptions of 17 new species of Cape orchids, chiefly from the Eastern districts, Natal, &c.; also a revision of some older species.

399 **ten Rhyne,** *Willhem,* Prof. Med. and Anat. Batavia, circ. 1674. *De frutice Thee, cui accedit Fasciculus Rariorum Plantarum a W. ten Rhyne in Prom. Bonae Spei et Saldanha Linn. anno 1673 collectarum atque simum ex India anno 1677 in Europam ad Jacobum Breynium Gedanensem ransmissarum.

Printed as an Appendix to Jacob Breyn's Exoticarum, &c., plantarum Centuria prima. (Art. 80.) Fol. pp. vii.—xxvi.
Libr. MacOw., Bol.

400 **Richard,** *Achille,* Prof. Bot. Paris, b. 1794, d. 1852. Monographie du Genre Hydrocotyle de la Famille des Ombellifères. Bruxelles, 1820. 8vo. 86 pp., 18 tab., sign. 50—67.

Roche, *see* **De la Roche.**

401 **Roth,** *Albrecht Wilhelm,* b. 1757, d. 1834. Botanische Abhandlungen und Beobachtungen. Nürnberg, 1787. 4to. 68 pp., 12 tab. col.

Contains (pp. 53—65) "observationes plantarum e Capite Bonae Spei." Unknown to us.

402 **Rottboell,** *Christen Friis,* Prof. Bot. Copenhagen, b. 1727, d. 1797. Beskrivelse over *Strelitzia Reginae* Kiöbenhavn. 1790. 4to.

We have not seen this, which is probably a reprint from the Act. lit. univ. Hafniensis.

403 [**Roupell,** Mrs. *A. E.*] *Specimens of the Flora of South Africa. By a Lady. London, 1849. Atlas folio. 10 col. plates.

The descriptive text, as is stated in the preface, is by the late Dr W. H. Harvey. The plates, for beauty and richness of colour, are amongst the finest specimens of botanical drawing.
Libr. S. Afr., Fairbr.

Roxburgh, Dr. *William,* see **Beatson,** Art. 60.

404 **Royen,** *Adrian van,* Prof. Bot. Leyden, b. 1705, d. 1779. *Ericetum Africanum. 43 tab., absque descriptione. (J. v. d. Spyk fecit, P. Cattell del.) Small folio.

An unpublished work, of which only the plates appear to have been printed, and are occasionally to be met with. They represent the external facies of some of the commoner Cape heaths, but are of little value to the student. The copy in Libr. Bol. has MS. annotations and corrections by the author.
Libr. MacOw., Bol.

Cryptogamic Botany.

405 **Reess,** *Max,* Prof. Bot. Erlangen. Ueber *Ustilago* (?) *capensis,* Reess, einen neuen Brandpilze von Cap der guten Hoffnung. In Sitzungsberichte der Phys. Med. Soc. zu Erlangen. 1875.

Description of a parasitic fungillus on *Juncus lomatophyllus,* Spr. Compare Buchenau, Monogr. der Juncaceen v. Cap (Art. 91), pp. 486—487; where figures are given.

406 **Reinsch,** *Paul Friedrich,* Prof. Univ. Erlangen. *Contributiones ad floram Algarum aquae dulcis Promentorii Bonae Spei. In Journ. of Linn. Soc.. vol. XVI. Lond. 1877. pp. 232—248. 1 plate.

The author enumerates 57 species collected near Cape Town by the Rev. A. E. Eaton, of which 16 are described as new.
Libr. Bol.

407 Rudolphi, *Friedrich Karl Ludwig,* b. 1801, d. 184
*Plantae Ecklonianae. Algae. In Linnaea, vol. VI. Berol. 1831. 8
pp. 171—181.
Libr. S. Afr., MacOw., Bol.

S

Phanerogamic Botany.

408 Salisbury, *Richard Anthony,* b. 1761, d. 1829. *On th
species of *Erica*. In Transactions of the Linnean Society, vol. VI. Londo
1802. 4to. pp. 316—388.
Enumerates 246 species, of which not a few were new; with brief diagnose
synonymy and references.
Libr. MacOw., Bol.

409 —— *The Genera of plants. A Fragment containin
part of Liriogamae. London, 1866. 8vo. vi., 143 pp.
Contains many notes of interest referring to Cape plants. The preface, by
J. E. Gray, gives a brief account of the talented author, who left behind him
MS. portions of a larger work, of which this was a fragment. It was published
by Dr Gray, a friend of Salisbury, as a memorial of him. (Sells about 5*s*.)
Libr. Bol.

410 Salm-Reifferscheid-Dyck, Prince *Joseph,* b. 1773, d. 1861.
*Verzeichniss der Verschiedenen Arten und Abarten des Geschlechts *Aloe*, welche von Willdenow, Haworth, De Candolle und Jacquin beschrieben worden oder noch unbeschrieben in der Gärten Deutschlands, Frankreichs und der Niederlande sich befinden. (Düsseldorf.) 1817. 8vo. 8, 73 pp.
A catalogue of the Aloes known to the author with brief characters and remarks upon critical species, intended as a precursor to his Monographia. This scarce little work seems to have been printed at a private press; the signature is that of a quarto, the size of page, however, resembles a duodecimo.
Libr. MacOw.

411 —— *Hortus Dyckensis, ou Catalogue des plantes cultivées dans les jardins de Dyck. Dusseldorf, 1834. 8vo. i.—viii., 1—376 pp., 3 plates, map.
A most interesting account of this important garden. A supplement, "Annotationes Botanicae," contains the projected arrangement for the monograph of *Aloe* and *Mesembryanthemum* (following this article) and descriptions of several new species.
Libr. MacOw.

412 —— *Monographia Generum *Aloes* et *Mesembryanthemi*.
Fasc. I.—VII. Bonnae, 1836—63. 4to. 377 tab., pro parte col. et text.
This fine work contains lithographed plates of 215 species of *Mesembryanthemum* and 162 of *Aloes*, several of them of double size. In each plate a single leaf or part of a leaf, and a single flower, only, are coloured. There is no table of contents or index. For collation of plates of *Mesembryanthemum* see Walpers' Annales Bot. Syst., vol. v. p. 18, and of Aloes, ibid., vol. VI. p. 130. Complete copies appear to be scarce, and unscrupulous booksellers, even of good standing, frequently palm off defective copies, without notice, upon the unwary

purchaser. "Caveat emptor" is the motto of many of them, and it cannot be too widely known. (Publ. 43 Th. Defective copies, with 350 to 352 plates sell at £5.)
Libr. P.E. (350 pl.), MacOw. (351 pl.), Bol. (352 pl.). S. afr. Faib.

Sanderson, *John,* see **Chapman,** Art. 131.

413 Saunders, *W. Wilson,* b. 1809, d. 1879. *Refugium Botanicum; or, figures and descriptions from living specimens of little-known or new plants of botanical interest. Edited by W. Wilson Saunders, F.R.S., F.L.S. The plates by W. H. Fitch. 5 vols. (in part). London, 1869—1878. 8vo.—Vol. I. 1869 (but plates 1—24 dated April, 1868). The descriptions by H. G. Reichenbach, Prof. of Bot. and Director of Bot. Garden, Hamburg; J. G. Baker, F.L.S., Assistant Curator of Kew Herbarium; and other Botanists; with notes on culture by W. W. Saunders. Plates 1—72.—Vol. II. Parts 1 and 2 (all published; dated respectively June 1869 and 1878). Descriptions by H. G. Reichenbach, and notes by W. W. Saunders. Plates 73—120.—Vol. III. 1870. Descriptions by J. G. Baker, and notes by W. W. Saunders. No explanation of plates as in vol. I.) Plates 145—216. Appendix on Scilla § *Ledebouria* and *Drimiopsis*, pp. 1—18. Index i., ii.—Vol. IV. 1871 (but 1st plate dated Sept. 1870). Descriptions by J. G. Baker, and notes by W. W. Saunders. Plates 217—288. Index.—Vol. V. Parts 1 and 2 (all published; dated respectively Nov. 1871 and July 1872). Descriptions by J. G. Baker, and notes by W. W. Saunders. Plates 289—336.

A series of beautiful plates, including not less than ninety Cape plants, many of them being critical species of great interest. It is much to be desired that a work so useful in the determination of many difficult Cape species, especially of bulbous plants, may be continued.
Libr. MacOw., Bol.

414 Savi, *Gaetano,* b. 1769, d. 1844. Osservazione sull' organi sessuali del genere *Stapelia.* [Torino.] 1835. 4to. c. tav.

415 Schlechtendahl, *Diedrich Franz Leonhard von,* Prof. Bot. Halle, b. 1794, d. 1866. *Ueber die Melanthiaceen am Vorgebirge der guter Hoffnung. In Linnaea, vol. I. Berol. 1826. pp. 78—95.

Libr. S. Afr., MacOw., Bol.

416 —— *Plantarum Capensium descriptiones ex schedis Bergianis (C. W. Bergius, non P. Bergius, aevi antiquioris). In Linnaea, vol. I. Berol. 1826. pp. 250—258.

Contains also a col. plate of *Schepperia juncea*, D. C. (*Cadaba juncea*, Benth. and Hook f.).
Libr. S. Afr., MacOw., Bol.

417 —— *Nachricht von *Ichthyosma Wehdemanni*, Schl. [*Sarcophyte sanguinea*, Sparrm.]. In Linnaea, vol. II. Berol. 1827. pp. 671—673, cum tab. col.

Libr. S. Afr., MacOw., Bol.

418 —— *Nachtrag zu *Ichthyosma Wehdemanni*, Schl. In Linnaea, vol. III. Berol. 1828. pp. 194—198.

This supplementary paper points out that the name *Ichthyosma* is inapplicable; the plant referred to having been already described by Sparrmann (in Köngl. Vetensk. Handlingar, vol. XXVII. 1776. p. 300, cum tab. 7) under the designation of *Sarcophyte sanguinea*, Sparrm.
Libr. S. Afr., MacOw., Bol.

419 Schlechtendahl, *Diedrich Franz Leonhard von.* *Observatio in *Plectroniae* genus. In Linnaea, vol. IV. Berol. 1829. p. 370.

Libr. S. Afr., MacOw., Bol.

420 —— *Plantae Ecklonianae.—Bruniaceae, Celastrineae, Rhamneae, Rutaceae. In Linnaea, vol. VI. Berol. 1831. pp. 188—208.

Libr. S. Afr., MacOw., Bol.

421 —— *Ueber die Verkäuflichen Pflanzen von Drège aus Sud-Afrika. In Linnaea, vol. X. Halle, 1836. p. 445.

Libr.

422 —— *Ueber die von Thunberg aufgestellten Carices. In Linnaea, vol. XIV. Halle, 1840. pp. 350—361.

Libr. MacOw., Bol.

423 —— *Ueber *Widdringtonia,* Endl. In Linnaea, vol. XXXIII. Halle, 1864. 8vo. pp. 339—361. Tab. 1.

A discussion of the several Cape species, with plate of the cones of *W. juniperoides* and *W. cupressoides.*
Libr. Bol.

424 Schrader, *Heinrich Adolf,* Prof. Bot. Göttingen, b. 1767, d. 1836. *Analecta ad Floram Capensem. I. Cyperaceae. Goettingae. 1832. 4to. 56 pp., 4 tab.

Contains excellent figures of 21 Cape Cyperaceae. (Sells for about 2s.)
Libr. MacOw., Fairbr., Bol.

425 Schultz, called **Bipontinus,** *Karl Heinrich,* b. 1805, d. 1867. *[Revision of Compositae.] In Walpers's Repertorium Botanices, vol. II. Lipsiae, 1843. pp. 538—704, 944—993. Vol. VI. ib. 1846—47. pp. 88—366.

Contains descriptions of Krauss's Natal collections, and other Cape species; all since incorporated in the 3rd vol. of Harvey and Sonder's Flora Capensis.
Libr. S. Afr.

426 Seemann, *Berthold,* b. 1825, d. 1871. *Abstract of a Journal kept during the voyage of H.M.S. Herald. In Hooker's Journal of Botany and Kew Garden Miscellany, vol. IV. London, 1852. 8vo. pp. 18—26, 82—92, 212—217, 238—242.

The third section of this abstract contains a sketch of the botany of such parts of the Cape peninsula as were visited by the author, and some curious memoranda respecting the Botanic Gardens of Cape Town in 1851.
Libr. S. Afr.

427 Shaw, *John.* *On the changes going on in the vegetation of South Africa through the introduction of the Merino sheep. In the Journal of the Linn. Soc., vol. XIV. London, 1874. 8vo. pp. 202—208.

The *Gomphocarpus* named *G. lanceolatus* by the author is *G. fruticosus,* R. Br. There is a notice of this paper in Trimen's Journ. of Bot. 1873. pp. 349—350.
Libr. Bol.

427a. —— *Remarks on *Roridula dentata.* In Trans. of the S. A. Philosophical Society, vol. I. Cape Town, 1878. 8vo. pp. 11—12.

Libr. Fairbr., MacOw., Bol.

428 **Smith,** *John,* Ex-Curator Bot. Gardens, Kew. *Observations on a remarkable Cycadaceous plant from Port Natal. In Hooker's Journ. of Bot. and Kew Gardens Miscellany, vol. VI. London, 1854. 8vo. pp. 88—90.

A note on *Stangeria paradoxa*, Moore. See Art. 355.
Libr. S. Afr.

429 **Sonder,** *Otto Wilhelm,* b. 1811, d. 1881. *Revision der Eriophileen. Hamburg, 1846. 4to. pp. 177—280, 13 tab. (numb. 17—29).

Reprinted from the "Abhandlungen des Nat. Hist. Vereins in Hamburg, Band I.
Libr. S. Afr., MacOw., Bol.

430 —— *Enumeratio Santalacearum in Africa Australi Extratropica crescentium quas Dr Ecklon et C. Zeyher collegerunt. In Flora, Regensburg, 1857 (21 Junii). 8vo. No. 23, 13 pp.

Respecting this and following memoir compare *De Candolle* (Art. 128).
Libr. MacOw., Bol.

431 —— *Nachschrift zu meiner Enumeratio Santalacearum Africae Australis. In Flora, Regensburg, 1857 (14 Julii). 8vo. No. 24. 7 pp.

Libr. MacOw., Bol.

432 —— *Enumeratio Orchidearum quas in Africa Australi Extratropica collegerunt C. F. Ecklon, Dr, et C. Zeyher. Auctore G. Sonder [sic]. In Linnaea, vol. XIX. Halle, 1846. 8vo. pp. 71—112.

Enumerates 155 species, with descriptions of the new ones.
Libr. MacOw., Bol.

433 —— *Beitraege zur Flora von Sud-Afrika. In Linnaea, vol. XXIII. Halle, 1850. 8vo. pp. 1—138.

Contains a large number of new species which have been absorbed into the Flora Capensis so far as it has proceeded.
Libr. MacOw., Bol.

Sonder, *O. W.* and *W. H.* **Harvey.** *Flora Capensis, see Art. 187.

434 **a Stapel,** *Joannes Bodaeus.* Theophrasti Eresii de historia plantarum libri decem, &c.: totum opus absolutissimis cum notis, tum commentariis: item rariorum plantarum iconibus illustravit Joannes Bodaeus a Stapel, medicus Amstelodamensis, &c. Amstelodami, Folio. 1187 pp., praef., ind., ic. xyl. i. t.

Respecting this work a note in Jacquin's "Stapeliarum, &c., descriptiones" (Art. 243) states "Speciem hujus generis quae innotuisse prima Europaeis videtur anno 1644 primus Joannes Bodaeus à Stapel, Med. Amst. in commentariis suis ad Theophrastum sub inepto Fritillariae crassae titulo promulgavit cum addita icone, ab Heurnio ex Africa missa, a se non visam vivam." Linnaeus also, in constituting the genus *Stapelia* (Hort. Cliffort.), says, "Dixi a Joanne a Bodaeo Stapel, laboriosissimo commentatore in Theophrasto, facile primus qui speciem detexit." Heurnius above mentioned is the same referred to by Thunberg as the earliest known collector of South African plants: "Heurnius, Justus, Sacerdos in Indiam Orientalem abiturus primus omnium Florae Capensis plantas legit fratrique suo Ott. Heurnio, Professori Leidensi transmisit. Numerus quidem plantarum exiguus fuit, cum brevi heic versatus excursiones suas eo tempore vix ultra viciniam montis Tabularis extendere potuisset; sed singulares hujus regionis gazae non modo rarissimae fuerunt, sed summam

quoque Botanicis Europaeis admirationem excitarunt." Stapel's Commentary has thus peculiar interest as containing probably the first description of a Cape plant, collected and sent to Europe at least nine years before the planting of the settlement by Van Riebeek. We have not seen the figure, but it must almost certainly be *Orbea variegata* Haw. (*Stapelia variegata* L.), the only species of *Stapelieae* which occurs in the vicinity of Cape Town.

435 Swartz, *Olof*, Prof. Bot. Stockholm, b. 1760, d. 1818. Genera et species Orchidearum systematice coordinatarum. s. l. 1805. 8vo. 108 pp., 1 tab.

Separately printed in Schrader's "Neues Journal für die Botanik," Band I. Göttingen. 1806.

436 —— *Synopsis Filicum, earum genera et species systematica complectens, &c. Kiliae, 1806. 8vo. xviii., 445 pp., 5 tab.

Also printed in Schrader's Journal, I. p. 1801.

437 Sweet, *Robert.* The British Flower Garden: containing coloured figures and descriptions of the most ornamental and curious hardy herbaceous plants, including annuals, biennials and perennials, &c. The drawings by E. D. Smith. London, 1823—29. 3 vols. 8vo. 300 col. plates and an equal number of pages of text.—Series the second. London, 1831—38. 4 vols. 8vo. 412 col. plates and an equal number of pages of text.

Contains plates of Cape plants. (Pub. £22. 16*s*.)

438 —— *Geraniaceae. The natural order of Gerania, illustrated by coloured figures and descriptions, comprising the numerous and beautiful mule-varieties cultivated in the gardens of Great Britain, with directions for their treatment. London, 1820—30. 5 vols. 8vo. 500 leaves. 500 col. plates.

The plates are quoted by Harvey in Flora Capensis, vol. I, but many of them are mere garden hybrids. (Publ. £19. Sells £5 to £6.)

Cryptogamic Botany.

439 Schkuhr, *Christian*, b. 1741, d. 1811. Vier und zwanzigste Klasse des Linné'schen Pflanzensystems oder Kryptogamische Gewächse. Erster Band mit 219 ausgemalten Kupfertafeln enthält ausser den sämmtlichen Farrnkräutern Deutschlands noch eine grosse Anzahl andrer aus allen Weltheilen, welche noch nicht oder zum Theil unvollkommen, auch nur in seltnen Werken abgebildet sind. Wittenberg, 1809. 4to. xiv., 212 pp., 219 tab. col., effigies autoris.

Contains figures of Cape Ferns cited by Pappe and Rawson. We have taken the number of plates as 219 from Pritzel. We have, however, seen them stated in two booksellers' catalogues as 222; and probably therefore the latter number is correct. (Publ. 45 th.; priced, Friedlander, 68 mk.)

440 Schlechtendahl, *D. F. L.* *Adumbrationes Plantarum. (Filices Capenses.) Fasc. I.—V. Berolini, 1825—32. 4to. 56 pp., 30 tab.

Contains excellent figures of Cape ferns. The work having been abandoned before its conclusion there is no title-page or index. (Publ. 4½ Th. Sells for about 10*s*.)

Libr. MacOw., Bol.

441 Shaw, *John.* *Introduction to the "Enumeratio Muscum, C. B. S." In the Cape Monthly Magazine, vol. IX. Cape Town, 1874. 8o. pp. 24—26.

Libr. S. Afr., P.E., Gr. Rt., MacOw., Fairbr., Bol.

442 ——*Catalogue of the Mosses of the Cape Colony: on the basis of Mueller's "Synopsis Muscorum Frondosorum," with short descriptions of new species. In the Cape Monthly Magazine, vol. XVII. Cape Town, 1878. 8vo. pp. 311—320, 376—383.

Libr. S. Afr., P.E., Gr. Rt., MacOw., Fairbr., Bol.

443 Spring, *Anton Fr.*, Prof. Anat. and Physiol. Liége, b. 1814, d. 1872. Monographie de la Famille des Lycopodiacées. (Extrait des tomes XV. and XXIV. des Mémoires de l'Académie royale de Belgique.) Bruxelles, 1842 and 1849. 4to. 110, 358 pp.

Contains the most recent revision of Cape Lycopodiaceae.

444 Stirton, *James.* *Additions to the Lichen Flora of South Africa. Reprinted from the Transactions of the Glasgow Society of Field Naturalists, part v. pp. 211—220. Glasgow, 1877. 8vo.

This paper enumerates about sixty species and varieties of Cape Lichens recently collected. Fourteen of these, being new, are briefly characterized.
Libr. S. Afr., MacOw., Bol.

445 Suhr, *Johann Nicolaus von*, b. 1792, d. 1847. [Memoirs on South African Algae.] In "Flora." 1834—40. Regensburg, 8vo., with figures.

We have not seen this.

446 Sullivant, *William S.* [Descriptions of Mosses.] In Proceedings of American Academy of Sciences. [Boston.] 1859. pp. 277—78.

Contains descriptions of 3 species of Cape mosses collected by C. Wright, of Wilkes' U.S. Survey expedition, when at Simonstown.

T

Phanerogamic Botany.

447 Tenzel, *Franz Bernhard Richard*, b. 1790. Nomenclator systematicus in Leonardi Plukenetii phytographiam. Erlangae, 1820. 8vo. 106 pp.

We have not seen this. (Publ. ⅓ Th.) Compare *Giseke*, Art. 171.

448 Thunberg, *Carl Pehr*, Prof. Bot. Upsala, b. 1743, d. 1822. *Travels in Europe, Africa and Asia. London, 1794—95. 4 vols. 8vo.—Vol. I. 317 pp., 2 plates.—Vol. II. 316 pp., 4 plates.—Vol. III. 285, 31 pp.—Vol. IV. 293 pp., 4 plates.

Translated from the original edition in Swedish, published at Upsala 1788—93. The first 2 vols. only contain an account of the South African travels, and are interspersed with valuable botanical notices.
Libr. S. Afr., Bol.

449 Thunberg, *Carl Pehr.* *Descriptiones Mesembryanthemorum quorundam in capitis bonae spei Africae interioribus regionibus anno 1774 detectorum. Norimbergae, 1791. 4to. 18 pp.

Reprinted from the Nova Acta Physico-Med. Acad. Caes. Leop. Carol., tom. VIII.

450 —— *Prodromus Plantarum Capensium quas in Promontorio Bonae Spei Africes [sic] annis 1772—75 collegit, pars I. et II. Upsaliae, 1794—1800. 8vo. 191 pp., 3 tab.

(Sells 6*s.*)
Libr. Bol.

451 —— *Flora Capensis, sistens plantas Prom. Bon. Spei Africes [sic] secundum systema sexuale emendatum, reductas ad classes, ordines, genera et species, cum differentiis specificis, synonymis et descriptionibus. Vol. prim. Fasc. I.—III. Upsaliae, 1807—13. 8vo. 578 pp.—Havniae, 1818—20. 8vo. Fasc. I.—V. 578, 352 pp.—*Edidit et praefatus est Joseph August Schultes. Stuttgardiae, 1823. 8vo. lxvi., 803 pp.

Thunberg was the first collector and botanist, after the revival of the science by Linnaeus, to grapple vigorously with the enormous mass of material presented by the Cape Flora, and he might be aptly termed the Father of Cape Botany. His descriptions are for the most part excellent, and the student may still often refer to his pages for information. (Pub., 3rd ed., 4 Th.) *Sells* about 10*s.*
Libr. S. Afr., MacOw., Fairbr., Bol.

The following Academical Dissertations by Thunberg were all published at Upsala:

452 —— *De *Gardenia.* 1780. 4to. 22 pp., 2 tab.

453 —— *De *Protea.* 1781. 4to. 62 pp., 5 tab.
Libr. S. Afr., MacOw., Bol.

454 —— **Oxalis.* 1781. 4to. 32 pp., 2 tab.

In this dissertation 26 species are described, of which 19 are Cape. Eight species are figured.
Libr. MacOw.

455 —— **Iris.* 1782. 4to. 36 pp., 2 tab.

Describes 43 species, of which 18 are South African. The 2 plates contain 5 figures.
Libr. MacOw.

456 —— **Ixia.* 1783. 4to. 24 pp., 2 tab.

Describes 24 species, all South African. Seven species are figured.
Libr. MacOw.

457 —— **Gladiolus.* 1784. 4to. 26 pp., 2 tab. (7 species).
Libr. MacOw.

458 —— De *Aloe.* 1785. 4to. 14 pp.

459 **Thunberg,** *Carl Pehr.* *De *Erica.* 1785. 4to. 62 pp., tab.

Describes 91 species, with details as to localities, time of flowering, &c. The plates contain excellent figures of 18 Cape species. There is another edition of this opuscule, edited by R. A. Salisbury (privately printed). Featherstone [London]. 1800. 4to. 62 pp., with additional plates. (3*s.* 6*d.*, Bohn.) We have not seen this.
Libr. MacOw., Bol.

460 —— *De *Moraea.* 1787. 20 pp., 2 tab.

Describes 21 species, of which 12 are Cape. Five Cape species are figured, of which *Moraea spathacea*, Thunb. is excellently rendered.
Libr. MacOw.

461 —— **Restio.* 1788. 22 pp., 1 tab.

Twenty-six species are here described, of which 7 are figured in the plate.
Libr. MacOw., Bol.

462 —— *De *Hermannia.* 1794. 4to. 19 pp., 1 tab.

Describes 27 species (Cape); with figure of *H. diffusa.*
Libr. MacOw.

463 —— *De *Diosma.* 1797. 4to. 20 pp.

Describes 32 species.
Libr. MacOw., Bol.

464 —— *De *Melanthio.* 1797. 4to. 10 pp.

Describes 20 species, of which 5 are South African.
Libr. MacOw.

465 —— De *Drosera.* 1797. 4to. 8 pp.

466 —— De *Hydrocotyle.* 1798. 4to. 8 pp., 1 tab.

467 —— *Arctotis.* 1799. 4to. 19 pp.

468 —— *Dissertationes Academicae Upsaliae habitae sub praesidio C. P. Thunberg (edidit C. H. Persoon). Goettingae, 1799—1801. III. voll. 8vo.—I.: 1799. viii., 326 pp., 5 tab.—II.: 1800. 436 pp., 3 tab.—III.: 1801. 272 pp., 12 tab.

A collection containing in the first 2 vols. all the foregoing and some other botanical dissertations. The 3rd vol. contains only zoological papers. Referring to the rarity of the originals as his reason for reprinting these, the editor says: "Plerarumque harum dissertationum exemplaria, inde a prima divulgatione in Upsalia adeo defecerunt ut eas pretio qualicunque sibi comparandi copia vix esset." The plates are partly the originals sent over by Thunberg himself, and partly improved copies. A fourth volume was promised but did not appear.
Libr. S. Afr., MacOw., Bol.

469 —— **Aspalathus.* Upsal. 1802. 4to. 2 fasc., 26 pp.
Libr. MacOw.

470 —— *De *Blaeria.* Upsal. 1802. 4to. 12 pp.
Libr. MacOw.

471 —— De *Antholyza.* Upsal. 1803. 4to. 10 pp.

472 **Thunberg,** *Carl Pehr.* De *Phylica.* Upsal. 1804. 4to. 10 pp.

473 —— De *Brunia.* Upsal. 1804. 4to. 8 pp.

474 —— **Thesium.* Upsal. 1806. 4to. 13 pp.

Describes 20 species.
Libr. MacOw.

475 —— De *Borbonia.* Upsal. 1811. 4to. 7 pp., 1 tab.

476 —— *In Genus *Echitis* Observationes. Upsal. 1819. 8 pp., 1 tab.

Two species are figured, of which one is South African.
Libr. MacOw.

477 —— *An illustration of the species of *Lycium* which grow wild at the Cape of Good Hope. In Trans. Linn. Soc., vol. IX. London 1808. 4to. pp. 151—155, with 4 plates.

Seven species are here enumerated. The plates are good.

*** The following list of papers contributed to various learned societies and journals is taken from Schultes's preface to the Flora Capensis:—

I. In Actis Reg. Acad. Scient. Holmens.

478 —— *Hydnora africana.* 1775. p. 67, c. tab.

479 —— *Obs. in *Hydnoram africanam.* 1777. p. 14, c. tab.

480 —— *Ehrharta.* 1779. p. 216, c. tab.

481 —— *Albuca.* 1786. p. 57.

482 —— *Willdenovia.* 1790. p. 26, c. tab.

483 —— *Cyanella.* 1794.

484 —— *Hydnora tetrandra.* 1808.

485 —— *Gladiolus Sparmanni.* 1814.

II. In Actis Acad. Caes. Natur. Curios.

486 —— *Crassulae* novae species 28.

487 —— *Mesembryanthemi* species novae 21.

III. Berolinensis. Natur. Scrutat.

488 —— *Dilatris* genus.

489 —— *Penaea.*

IV. Nidrosiensis Societ.

490 —— *Hypoxis* genus.

491 —— *Cliffortiae* genus.

V. Lundensis Physiograph.

492 **Thunberg,** *Carl Pehr. Retzia capensis.* 1776. c. fig.

493 —— *Montinia* et *Papiria.* 17.

494 —— Aloes paratio in Africa. 17.

495 —— *Aitonia capensis.* 17. c. fig.

496 —— *Falkia repens.* c. fig.

VI. Upsaliensis Societas Litter.

497 —— *Cycas caffra* (*Zamia*). 1775. Vol. 2, c. fig.

VII. Parisiens. Histor. Natur. Societ.

498 —— Descriptio 15 japonic. et 341 capens. incognit. plan-
rum.

VIII. Parisiens. Soc. Medic. d'Emulation.

499 —— *Avenae* Capenses. 1810. c. fig.

IX. Societ. Nancyens. Scientiar.

500 —— *Carices* Capenses 4. 1810. c. fig.

X. Hafniensis Hist. Nat. Societ.

501 —— *Gorteriae* species.

502 —— *Gladioli.*

XI. Londinensis Linnean. Soc.

503 —— *Chironiae.* c. tab. 2.

—— *Lycia* Capensia. c. tab. 4. See Art. 477.

XII. Hallensis Soc. Natur. Scrutat.

504 —— *Oenanthis* species capenses 18.

XIII. Gorengkensis Soc. Phytograph.

505 —— Gramina capensia. 1811. c. tab.

506 —— *Trachelium, Roella,* &c. 1811. c. t. 4.

507 —— *Lobeliae* capenses. 1811. c. fig. 11.

508 —— *Rhamni* capenses. 1812. c. fig., 2 col.

509 —— *Solana* capensia. 1812. c. fig., 2 col.

510 —— *Celastri* novae species capenses. 1812. c. fig.,
5 col.

XIV. Moscow. Imper. Litter.

511 Thunberg, *Carl Pehr. Poae* Capenses, tom. III. pp. 43—48. c. tab. 4.

XV. In Schrader's Journal.

512 —— Genera duo nova plant. capens., vol. I. p. 517.

513 —— *Diosma.*

514 —— Asperifoliae (?). c. t. 1.

XVI. Weberi Journal.

515 —— *Ixiae* 5, *Restiones* 5, *Diosmeae* 5, *Cynanchi* sp. c. tab.

516 —— Orchideae capenses. Beitrage 2 B p. 1. 1813.

XVII. Petropolitana Acad. Scient.

517 —— *Hermas.* Nov. Act., tom. 14, p. 527. c. tab. 2.

518 —— *Proteae* novae, ibid., tom. 15 (1806), p. 458. c. tab. 4.

519 —— *Galii* species capenses. Memoir, tom. 1, p. 326. c. tab. 4.

520 —— *Campanulae* capenses. Mem., tom. 4, p. 364. c. tab. 3.

521 —— Descr. 4 spec. nov. *Proteae,* ibid., tom. 6 (1818), p. 346. c. tab. 4.

522 Tilli, *Michelangelo,* Prof. Pisa, b. 1655, d. 1740. Catalogus plantarum Horti Pisani. Florentiae, 1723. Folio. xii., 187 pp., 50 tab., iconographia horti, effigies Tilli.

A somewhat rare work, quoted by the earlier writers, containing figures of a few Cape plants.
Libr. MacOw.

523 Todaro, *Agostino,* Direct. Bot. Gard. Palermo. *†Hortus Botanicus Panormitamus, sive plantae novae vel criticae quae in horto botanico Panormitano coluntur, descriptae et iconibus illustratae. Panormi, Fasc. 1—6. 1875—76. Fol. max.

This splendid work has already illustrated an *Erythrina* (*E. insignis,* Tod.) scarcely more than a variety of *E. caffra,* an Aloe, and three species of *Stapeliae.* (Pub. 10 fr. each fasc. Offered by Voigt 19 mk. 40 pf. for the six fasc.)
Libr. MacOw. (fasc. 1—4).

524 Trimen, *Roland,* Curator S. A. Museum, Cape Town. *On the fertilization of *Disa grandiflora,* L. In Journal of Linnean Soc., vol. VII. London, 1864. 8vo. pp. 144—47 (woodcut).

A paper of much interest.
Libr. Bol.

525 Trimen, *Roland.* *On the structure of *Bonatea speciosa* ith reference to its fertilization. In Journ. Linn. Soc., vol. IX. London, 6. pp. 156—160 (plate).

Libr. Bol.

526 —— *Vegetation of Little Namaqualand. In Trimen's urn. of Bot., vol. II. N.S. Lond. 1873. pp. 381, 382.

Libr. S. Afr., MacOw.

527 —— *Abnormal *Stapeliae.* In Trimen's Journal of Bot., ol. III. N.S. Lond. 1874. p. 185.

A note on chorisis in *Stapelia.*
Libr. S. Afr., MacOw.

Cryptogamic Botany.

528 Taylor, *Thomas,* M.D. *New Lichens, principally from the Herbarium of Sir W. J. Hooker. In Hooker's London Journal of Botany, vol. VI. London, 1847. 8vo. pp. 148—197.

Includes eight Cape species.
Libr. S. Afr., Bol.

529 Thuemen, *Felix von.* *†Mycotheca Universalis. Cent. I.—V. Baireuth; cent. VI.—XII. Klosterneuburg, 4to. min. 1875—1879.

A collection of herbarium specimens of Fungi from all parts of the world in 4to. cartons of 100 examples (at 12*s.* each). In this work very many S. African Fungi have already been distributed.
Libr. MacOw.

530 —— *†Diagnosen zu Thuemen's "Mycotheca Universalis." Reprint from the "Flora." Regensburg, 8vo. 1876 (no. 13), 1877 (no. 11, 13), 1879 (no. ——).

A convenient form for reference to the novitiae of the foregoing work.
Libr. MacOw.

531 —— *Fungi Austro-Africani. In the "Flora." Regensburg, 1875 (no. 24), 1876 (nos. 13, 23, 27, 36), 1877 (nos. 11, 13, 26), 1878 (no. 23).

These papers contain about 100 Cape Fungi collected by MacOwan, with diagnoses of the new species.
Libr. MacOw.

V

Phanerogamic Botany.

532 Volckamer, *Johann Georg,* b. 1662, d. 1744. *Flora Noribergensis, sive Catalogus plantarum in agro Noribergensi tam sponte nascentium, quam exoticarum, &c. &c. cum iconibus et descriptionibus rariorum aliquot plantarum. Noribergae, 1700. 4to. pp. i.—xii., 1—407 et iii.

addend., tab. 115.—A second edition, Norimbergae, 1718. 4to. 407 pp. tab. 115 does not otherwise differ.

Contains tolerable figures of seventeen Cape plants. The Catalogue is alphabetical and gives copious notes and synonyms. Linnaeus characterises it as "opus laudabile."
Libr. MacOw., Bol.

533 Vriese, *Willem Hendrik de,* Prof. Bot. Leyden, b. 1806 d. 1862. *Nova species Cycadearum Africae Australis quas descriptionibus et figuris illustravit W. H. de Vriese. Amstelodami, 1837. 8vo. 17 pp. tab. I.—V.

To this opuscule there are five excellent plates numbered 1—5, but in the text they are referred to as 6—10. It is a reprint from the Tydschrift voor Natuurlyke Geschiedenis en Phys., deel IV. 1837. 8vo. pp. 409—425. Tab. VI.—X.—*Encephalartos Marumii*, Vriese, published in the same work (deel V. 1838. pp. 187—189) is a slight variation of *E. Altensteinii*, Lehm., to which it is reduced in D. C., Prodr. XVI. p. 532.
Libr. MacOw., Bol.

534 —— *De *Encephalarto Lehmanni*, Eckl. animadversiones. 8vo. Hoeven en Vriese, Tijdsch. X. (1843) pp. 57—67; sep. pp. 1—11 [no title-page or imprint].

A letter dated Amsterdam 1842, addressed to Prof. F. A. G. Miquel.
Libr. MacOw.

W

Phanerogamic Botany.

535 Walpers, *Wilhelm Gerard.* *Animadversiones Criticae in Leguminosas Capenses. In Linnaea, vol. XIII. Halle, 1839. 8vo. pp. 449—543.

In this painstaking opuscule is a curious statement with regard to the priority of Ecklon's Enumeratio over Eilleyer's Commentaries on Drège's plants:—"Ecklon, ut jam satis constat apud omnes botanicos *Enumerationem Plant. Afr. Austr. Extratropicae*, ineunte anno MDCCCXXXVI. edidit; Ernesti Meyeri contra *Commentarii*, licet in fronte annum MDCCCXXXV. gererent, complures menses post Ecklonii descriptiones in lucem prodiere, ut jam alio loco commemoratum est. Illum falsum editionis terminum quasi calami lapsu vel errore typographico ortum esse eo magis contendo, quum omnibus quae videre licuit exemplaribus *Commentariorum* proclamationem ineunte Februario anni MDCCCXXXVI. adscriptam conspexerim, et propterea non potui quin Ecklonis plantarum ab eo primo descripto prioritatem reservarem." p. 451. (Compare note to Art. 162.) Here the word "adscriptam" refers to the MS. filling in of the date appended to Drège's conditions of sale of plants, as printed inside the cover of the *Commentaries*. Librarians should carefully retain this printed paper cover as a title-page to that work.
Libr. MacOw., Bol.

536 —— Animadversiones criticae in Leguminosas Capenses herbarii regii Berolinensis. Diss. Halae, 1839. 8vo. 99 pp.

A reprint of the preceding article.

537 Walpers, *Wilhelm Gerard.* *Repertorium botanices systematicae. Lipsiae, 1842—48. VI. voll. 8vo.

Tomus I.: 1842. (Ranunculaceae—Mimoseae; index generum.) iv. 947 pp.

Tomus II.: 1843. (Chrysobalaneae—Monotropeae; supplementum primum Repert. Bot. Syst., tom. I. et II.: Ranunculaceae—Gesneriaceae; index nerum tomi I.—II.) viii., 1029 pp.

Tomus III.: 1844, 45. Synopsis Solanacearum, Scrophularin., Orobanch., Labiat. in botanicorum scriptis ad hunc diem editis descriptarum. (Addnda et corrigenda; synopsis generum; index generum.) xii., 1002 pp.

Tomus IV.: 1844—48. Synopsis Verbenacearum, Myoporin., Selagin., tilbin., Globular., et Plantagin. omnium ad annum MDCCCXLIV. cognitarum. ıdditus est index ordinum, subord., gen., spec., et synon., omnium in Repert. ot. syst., fasc. I.—XXVI. obviorum. viii., 821 pp.

Tomus V.: 1845, 46. Synopsis plantarum exogenearum dialypetalarum mnium inde ab anno MDCCCXLIII. detectarum exhibens suppl. tertium ad rdines XCVI. priores Vegetabilium in Prodr. Candoll. descript. (Ranunculaceae—Loranthaceae; index generum.) viii., 982 pp.

Tomus VI.: 1846, 47. Synopsis plantarum exogenearum gamopetalarum post Prodr. Candoll. tomum decimum et Repert. bot. syst. fasc. decimum sextum editos detectarum. (Lonicereae—Plantagineae; additamenta; index generum, fasc. I.—XXVI.) viii., 834 pp.

The greater part of the orders beyond Campanulaceae here treated of are absorbed in the later vols. of the Prodromus, and thus possess little special importance to the Cape student. (Pub. 30⅔ Th. Priced by Friedlander 8 Mk.) Libr. S. Afr.

538 —— *Annales botanices systematicae, vol. I.—VII. Lipsiae, 1848—68. 8vo.

I.: 1848, 49. Synopsis plantarum phanerogamicarum novarum omnium per annos 1845—47 descriptarum. vi., 1127 pp.

II.: 1851, 52. Synopsis plant. phanerogam. thalamiflor. et calyciflor. omn. per annos 1848—50 descript. 1125 pp.

III.: 1852, 53. Synopsis plant. phanerogamic. corrolliflor., monochlamyd. et monocotyledon. omn. per annos 1848—50 descript. 1168 pp.

IV.—VI.: 1857—60. Synopsis plant. phanerogamic. nov. omn. per annos 1851—55 descript. auct. Carolo Mueller. Berol. viii., 959, 966, 1309 pp.

VII.: 1868. Addenda ad literaturam botanicam annorum 1856—66. 960 pp.

The portions of this invaluable work of reference which contain the most Cape plants are vols. I. and VI. (Orchideae), and vol. II. (Leguminosae). Much of the latter is, however, rendered unnecessary to the Cape student by the Flora Capensis of Harvey and Sonder. (Pub. 49 th. 26 sgr. Sells £6 to £7.) Libr. MacOw., Bol.

539 [Watson, *Alexander.*] Flora Sta. Helenica. St Helena, 1825. 4to. v., 20 pp.

Contains an introduction written in English and a catalogue of plants arranged according to the Linnean system, with English names added. The author is said to be A. Watson, a military officer. (Pritzel.) Unknown to us.

540 Wayne, *E. S.* Researches on Buchu. In American Journal of Pharmacy, vol. VI. p. 18.

Veale, *J. P. Mansel.* Notes on the Structure and Fe
the genus *Bonatea*, with a special description of a new speci
lford, South Africa. In Journal of the Linnean Soc., vol.
. 8vo. pp. 470—476.

—— *Notes on a species of *Disperis* found on th
uth Africa. —— *Some observations on the fertilisation of *Di
—— *Notes on some of the species of *Habenaria* found in Sou
Observations on the mode in which certain species of Asclepiade
In Journal of the Linnean Society, vol. XIII. London, 187
–58.

Veinmann, *Johann Wilhelm.* Phytanthozoiconographia,
us aliquot millium tam indigenarum tam exoticarum ex quatuor
us longe annorum serie indefesso que studio a Joh. Guil. Wein-
&c. Ratisbonae, 1737—45. IV. voll. folio.—I.: 1737, A—B.
col. 1—275.—II.: 1739, C—F. 516 pp., tab. col. 276—525.—
—O. 488 pp., tab. col. 526—775.— IV.: 1745. 540 pp., tab. col.
raef. Halleri, ind.

s also a Dutch edition in 4 vols. Amsterdam, 1736—48.—Contains
es of Cape plants. (Offered, 1878, at 100 Mk.)

ınd, *H. L.*, see **Bartling.**

Vendland, *Johann Christoph*, Direct. Gardens, Herren-
755, d. 1828. *Ericarum icones et descriptiones. Abbildung
ibung der Heiden. Fasc. I.—XXVII. Hannover, 1798—1823.
90, 34 pp., 162 tab. col.

tes of this work are quoted in Bentham's Monograph in De Candolle's
s, but they are very inferior to those of Andrews (Art. 4). (Publ.
Sells at 70*s*.)
Afr. (copy with several plates wanting).

—— *Collectio plantarum tam exoticarum quam indi-
ı delineatione, descriptione, culturaque earum. Sammlung aus-
ınd einheimischer Pflanzen, mit ihrer Abbildung, Beschreibung,
Hannover, 1808—19. III. voll. 4to. vii., 98, 82, 24 pp., 84 tab. col.

ıs tolerable figures of many Cape plants, chiefly Diosmeae, Bruniaceae,
eae, with analyses. The text gives description and occasional ex-
rticultural details. (Publ. 28 Th., reduced to 18 Th.)
Ow. (an incomplete copy).

Vikstroem, *Johan Emanuel*, Prof. Bot. Stockholm, b.
6. *Granskring af de till Thymelearum växtordning hörande
rter. In Act. Acad. Scient. Holm. 1818. pp. 263—354, 1 tab.

efacé of this memoir only is in Swedish, the dissertation in Latin.
shews 2 species of *Lonchostoma*.
Ow.

Vilhelmi, *Carl.* Verzeichniss extra-australischer Pflanzen,
eit Entdeckung der Colonie Victoria bis zum Jahre 1869 unaus-

tbar eingebuergert haben. In Sitzungsbericht der Gesellsch. Isis. 1873. . 96, 97.

Contains reference to the spread of the so-called "Cape weed," *Cryptostemma calendulaceum*, R. Br. and *Solanum sodomaeum*, L. throughout the colony of Victoria.

548 **Willdenow,** *Carl Ludwig*, Prof. Bot. Berlin, b. 1765, 1812. Bemerkungen ueber die Gattung *Aloë*. In Magazin der Gesellschaft aturforsch. Freunde. Berlin, 1811.

Quoted by Salm-Dyck in his Verzeichniss (Art. 410).

549 —— *Ueber die Gattungen *Brunia* und *Staavia* [no title-age or date]. 4to. pp. 125—134, 3 tab.

A re-impression from the Muenchen Denkschr. (1808). The plates are excellent, and represent six species.
Libr. MacOw.

550 **Wyley,** *Andrew*, Cape Colonial Geologist, 1857. *†Report upon the Mineral and Geological structure of South Namaqualand and the adjoining mineral districts. With appendix (p. 40). Notes upon the botanical features of Namaqualand. Cape Town, 1857. Presented to both Houses of Parliament by His Excellency the Governor.

The botanical notes in the Appendix are valuable, and contain the fullest account yet published of the botany of that little-known region.

Cryptogamic Botany.

Wahlberg, *Johan August*, b. 1810, d. (Lake N'Gami), 1857, see **Fries,** Art. 170.

Z

Phanerogamic Botany.

551 **Zeyher,** *Carl Ludwig Philipp*, b. 1799, d. (Uitenhage) 1858. *Botanical notices on a journey into the interior of Southern Africa, in company with Mr Burke. In Hooker's Lond. Journ. of Bot. and Kew Gard. Miscellany, vol. VII. London, 1855. 8vo. pp. 326—334.

Zeyher was for many years an indefatigable collector of Cape plants. His name is most familiar in connection with that of Ecklon, with whom his earlier journies were undertaken; but in 1840—41 he travelled in company with Joseph Burke, and the foregoing is an extract from his journals after he had parted company with Burke, whose own account is referred to under Art. 97.
Libr. S. Afr., MacOw.

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JULY, 1881.

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OF THE

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VOLUME III.

1881—83.

CAPE TOWN:
PRINTED FOR THE SOCIETY BY SAUL SOLOMON & CO.
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* The Rules of the Society provide that the President's office cannot be held by the same person for more than two years consecutively.

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MINUTES OF PROCEEDINGS.

Ordinary Monthly Meeting.

WEDNESDAY, August 31, 1881.

PROFESSOR GUTHRIE IN THE CHAIR.

The thanks of the Society were voted to the Royal Society of New South Wales, Sydney, for the following books, viz :—

Journal and Proceedings of the Royal Society of New South Wales, 1879.
Annual Report of the Department of Mines, for the Years 1878-79.
Report upon certain Museums for Technology, Science and Art, 1880.
Report of the Council of Education upon the condition of the Public Schools, for 1879.

Professor McOwan read a paper on "Recently discovered Phalloid Fungi of South Africa."

Mr. H. W. Oakley read a paper on the Osteology, etc., of the Secretary Bird (*Serpentarius reptilivorus*).

Both members and visitors took part in the discussion that ensued at the close of each paper.

Ordinary Monthly Meeting.

WEDNESDAY, September 28, 1881.

DR. GILL, F.R.A.S., VICE-PRESIDENT, IN THE CHAIR.

Dr. Saunders, of Cape Town, and Mr. M. M. Tait, of Newlands, were elected Ordinary Members of the Society.

The following gentlemen were elected Corresponding Members, viz :—

Professor Gustav Fritsch, of Berlin.
„ Richard Lepsius „
„ Robert Hartmann „
„ Fred Muller, of Vienna.
„ A. F. Hovelacque.
„ Vinson, of Paris
W. H. Penning, F.G.S., of Kimberley.

The thanks of the Society were voted to the donors of the following books, etc :—

Dr. Holub :

Seven Years in South Africa, by Dr. Holub, translated by Ellen Frewer, 1881.

C. B. Elliott, LL.B. :

Report on the Mortality experience of the Mutual Life Assurance Society of the Cape of Good Hope, 1881.

Dr. Schwarzbach, introduced by the Vice-President, delivered a lecture on "The Human Eye, and how to guard it."

Ordinary Monthly Meeting.

WEDNESDAY, October 26, 1881.

MR. JOHN G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Dr. Shaw exhibited a new fossil lizard from the Upper Karroo Shales of Albania, Griqualand West. He stated that the Shales in which it was found are the same as those which form the reef of the Kimberley Diamond Mine.

Dr. Shaw also exhibited two primitive implements from the Knysna Caves. He also exhibited some specimens of Knysna woods, and remarked on the administration of the Knysna forests.

Mr. Gamble exhibited and commented on a wall-diagram showing measurement of rainfall as given by the different gauges at the Royal Observatory.

Mr. Oakley exhibited some fossil reptilian remains from the Beaufort District. He also exhibited two Locust Birds (*glareola melanoptera*) recently shot at Eerste River.

Ordinary Monthly Meeting.

WEDNESDAY, November 30, 1881.

MR. JOHN G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

The thanks of the Society were voted to Dr. Gill for his work entitled *A Determination of the Solar Parallax.*

Mr. Oakley exhibited a meteorite and some birds.

The President read a paper on "Summer and Winter Temperature in South Africa."

The Acting Secretary read a letter from Mr. Hyde Clarke, complaining of Dr. Hahn's critique on his paper in Vol II. Part I. of the Society's Transactions, entitled "On the Languages of the Mozambique and of the South of Africa, in their relation to the Languages of Australia."

Dr. Hahn commenced a reply to Mr. Hyde Clarke's communication, which was postponed until the next Ordinary Monthly Meeting.

Ordinary Monthly Meeting.

WEDNESDAY, January 25, 1882.

Dr. GILL, F.R.A.S., VICE-PRESIDENT, IN THE CHAIR.

A donation from Dr. E. Holub of a pamphlet entitled *Die Colonisation Africas; Die Französen in Tunis*; von Dr. Emil Holub; Wien, 1881, was announced, and the thanks of the Society voted to the donor.

A letter from Monsieur L. A. August Latour, Vice-President of the Natural History Society, Montreal, was read, in which he invited any Members of the Society to attend a Scientific Congress under the direction of the "American Association for the Advancement of Science," to be held this year at Montreal.

Mr. Oakley exhibited some specimens of the Cotton Bird (*Anthoscopus Capensis*) and nest.

Dr. Th. Hahn completed his reply to Mr. Hyde Clarke's communication, which had been postponed from the last meeting.

Ordinary Monthly Meeting.

WEDNESDAY, February 22, 1882.

Mr. R. TRIMEN, F.L.S., &c., IN THE CHAIR.

Mr. Polus gave notice that at the next meeting he should move that Rule 5 be altered as follows, viz.: Six members to form a quorum for the election of new members, instead of ten.

The thanks of the Society were voted to Dr. Holub for the donation of his pamphlet entitled *Ueber die Vögelwelt Südafrikas.*

Mr. Oakley exhibited the skulls of two snakes, one a cobra, the other probably *Coronella Cana.* The cobra was caught in the act of swallowing the mole-snake, a small portion only of the tail of the latter being seen protruding from the mouth of the cobra. Upon dissecting the mole-snake a large rat was found in its stomach.

In the discussion which ensued Messrs. Fisk, Bolus and Trimen took part.

Mr. C. Lloyd Morgan read a remarkably interesting paper entitled "Notes on Animal Intelligence."

In the discussion which took place Messrs. Trimen, Guthrie, Bolus and Fisk contributed.

Ordinary Monthly Meeting.

WEDNESDAY, March 29, 1882.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. Bolus' motion, of which he gave notice at the last meeting, was carried unanimously, with an addition that negative votes to the amount of one clear sixth of the votes recorded shall exclude a candidate.

Messrs. R. Kearns and W. Hiddingh, of Cape Town, were duly elected Ordinary Members of the Society.

The following donations were announced and the thanks of the Society voted to the donors :—

(1) Dr. Holub :

Beiträge zur Ornithologie Südafrikas.
Sieben Jahre in Süd-Afrika.
Ueber die Vögelwelt Südafrikas.

(2) Dr. Wladislav Schier :

Die Schädlichen Vögel.
Blätter des Böhmishen Vögellschutzvereines in Prag.

(3) Royal Society of New South Wales :

List of Scientific Papers and Reports.

Mr. Trimen exhibited some skins of birds from Mossamedes, etc., collected and presented to the South African Museum by Mr. A. W. Eriksson, one species of which, a Sun Bird, was probably new to science. It had points of affinity to *Cinnyris afer*, *C. Chalybeus* and *C. Chloropygia*, but differed materially from all. In the event of its being hitherto undescribed Mr. Trimen proposed to name it after its discoverer, viz :—*Cinnyris Erikssoni*. Among the skins exhibited were also several specimens of the rare thrush *Chætops pycnopygius sclater* and of the beautiful Plaintain-eater *Corythaix Livingstonii*, Gray.

Mr. Trimen read notes from a letter of Dr. Bradshaw on some of the Birds of the Orange River, in the neighbourhood of Olyvenhout's Drift, &c., Northern Border of Cape Colony. Mr. Trimen called attention to Dr. Bradshaw's statement in his letter that he had obtained a specimen of the very rare and small hawk *Poliohierax semitorquatus* ; and also to the absence of the Cuckoo Tribe, and scarcity of Kingfishers.

Dr. Gill exhibited a diagram to show some most remarkable changes

in the direction of the Wind on Monday, March 27. There seemed to be little doubt but that some portions of several cyclones passed over the Observatory on that date.

Dr. Gill read a paper "On the effects of different exposures of Thermometers in estimating the Temperature of the Air."

In the discussion that ensued Messrs. Gamble, Bolus and Lloyd Morgan took part, Mr. Gamble giving some reasons why he distrusted the Glaisher Stand, and describing an observing hut at Lovedale erected by Mr. Smith.

Ordinary Monthly Meeting.

WEDNESDAY, April 26, 1882.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. C. E. Solomon, of Cape Town, was duly elected an Ordinary Member of the Society.

The following donations were announced and the thanks of the Society voted to the donors:—

(1) Dr. Holub:

Uber einige fossilien aus der Uitenhage formation in Süd Afrika.

(2) Sir Bartle Frere:

On the Laws affecting the relation between civilized and savage life.

Mr. Gamble exhibited and explained a model of a Sun-engine, which was intended to boil water and cook food, etc., by the sun's heat. Mr. Gamble referred to some experiments by Professor Guthrie on the radiant heat of the sun. Professor Guthrie explained the results of his experiments with plates of glass, and concluded that the method of concentrating heat with parallel plates of glass was better than that of a reflector. Professor Guthrie calculated that he got $1\frac{1}{3}$ horse power in six hours.

Mr. Gamble then read a paper on "The Table Mountain Water Supply."

The Hon. A. Ebden, Chairman of the Water Company, explained how it was that the Water Company arose, viz.:—To supply a want that the authorities of Cape Town did not seem to be inclined to meet.

The Hon. C. A. Smith supported the scheme as benefiting the whole community.

In answer to a question from Mr. Rutherfoord, Mr. Gamble stated the rainfall on the top of Table Mountain as 87 inches during the year ending 1882, March.

The proposed reservoir is to hold 120,000,000 gallons, as estimated in a report for the Town Council.

Ordinary Monthly Meeting.

WEDNESDAY, May 31, 1882.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. W. M. Grier, Chief Inspector of Public Works, was duly elected an Ordinary Member of the Society.

The following donations were announced, and the thanks of the Society voted to the donor :

Beiträge zur Paläontologie Oesterreich-Ungarns.
Die Süd-Afrikansche Vögelwelt.

Mr. Gamble gave notice of motion that Rule 3, page 8, be amended by substituting the word "three" instead of "one."

Mr. H. W. Oakley read a paper on the "Anatomy and Habits of some of the Venomous and Non-venomous snakes of South Africa."

In the discussion which ensued, the following gentlemen took part, viz :—

Messrs. Gamble, Trimen, Lloyd Morgan, Rutherfoord, Finlay, Dr. Fisk and Dr. Kitching.

At the close of the discussion the thanks of the Society were voted to Mr. Oakley for his interesting paper.

Ordinary Monthly Meeting.

WEDNESDAY, June 29, 1882.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. Thornton, Chief Locomotive Superintendent, was duly elected an Ordinary Member of the Society.

The following donations from Dr. Holub were announced and the thanks of the Society voted to the donor :

Fossil-Insecten aus dem Diatomeenschiefen von Kutschiefer von Kutschlin bei Bilin, Böhmen von Dr. J. V. Deichmüller.
Ueber die fossilien Pflanzen des Susswassersandsteins von Grasseth. Ein neuer Beitrag zur Kenntniss der fossilien Pflanzen Böhmens von H.Engelhardt.

It was announced that some objects for exhibition had been forwarded, but it was deemed advisable to hold them over till the next meeting.

Mr. Gamble's motion that in Section II, Rule 3, page 8, the words "three visitors" be substituted for "one visitor," was carried unanimously.

Dr. Hahn then read his paper on "African Exploration," and at its close the thanks of the Society were voted to Dr. Hahn.

Annual General Meeting.

WEDNESDAY, July 26, 1882.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

The Reports of the Secretary and Treasurer were read and unanimously adopted.

The meeting then proceeded to the election of the President and Council for the ensuing year; Messrs. Trimen and Fisk being elected scrutineers.

The President then delivered his annual address to the Society, the subject being "The Barometer and the Winds."

At the conclusion of the address, a vote of thanks to the President was proposed by Dr. Gill and carried unanimously.

The scrutineers then declared the result of the election as follows :—

President,—J. G. Gamble, M.A., M.I.C.E.

Members of Council,—H. Bolus, F.L.S., W. H. Finlay, B.A., F.R.A.S., David Gill, LL.D., F.R.A.S., F. Guthrie, LL.B., P. C. MacOwan, B.A., Hon. J. X. Merriman, M.L.A., C. Lloyd Morgan, J. Sivewright, M.A., C.M.G., Hon. C. A. Smith, M.A., R. Trimen, F.L.S., F.Z.S.

REPORT ON THE PROCEEDINGS

OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY

DURING THE YEAR ENDING JULY 26TH, 1882.

1. Since the last Annual General Meeting on July 29th, 1881, ten Ordinary Monthly Meetings have been held. The average attendance of members at these meetings has been 12 and of visitors 15.

2. At the monthly meetings 12 Memoirs have been read. Of these one related to Botany, four to Zoology, one to Anatomy, one to Mechanics, two to Meteorology, one to Philology, one to Hydraulic Engineering, and one to Travels and Exploration.

The discussions on these papers have possessed considerable interest and have often added materially to the value of the paper. An attempt was made by the Council to preserve a record of these discussions, for printing in the Transactions, but it was abandoned on account of the expense.

3. Several valuable books have been received during the year, but many more may be expected in exchange for our publications from the various Scientific Societies in other countries. The thanks of the Society have been voted to our constant friends Dr. Holub, and Sir Bartle Frere, to D. Gill, Esq., LL.D., C. B. Elliott, Esq., LL.B., the Royal Society, New South Wales, and the Australian Museum, Sydney, for donations.

All books belonging to the Society are now stored in a room on the premises of the Mutual Assurance Society, and are available for the use of members on application to the Council. It is desirable that a catalogue of them be formed and distributed to members.

4. During the year six ordinary members have been elected. Two ordinary members have resigned, three have left the Colony, and the Society has lost two by death. At present there are seventy-five ordinary and twenty corresponding members.

5. The printing of the Transactions and Memoirs to the end of December, 1881, has been intrusted to Messrs. Macmillan and Bowes, and the volume may be expected almost daily. A wish has been expressed by the publishers to retain copies of the volumes of the Society for sale in England.

6. The lectures on scientific subjects, which were commenced last year at the wish of a large number of the members, were discontinued at the end of the year: the attendance of members and of the general public was not sufficient to encourage their continuation.

7. The Society is much indebted to the University Council for granting the free use of its rooms for the Society's meetings.

8. The Council considers that the Society may be fairly congratulated on the position it has maintained during the year. It is to be regretted, however, that more papers have not been contributed by the members generally: the contributions being confined mainly to three or four of our number. A circular was issued inviting short notes on any matter of interest, but without result so far.

By Order of the Council,

W. H. FINLAY, General Secretary.

THE TREASURER IN ACCOUNT WITH THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

Dr. 1881-82.	£	s.	d.	£	s.	d.
To Balance { in Standard Bank Pass Book	132	16	3			
To Balance { Fixed Deposit	200	0	0			
				332	16	3
To Subscriptions { Current	134	0	0			
To Subscriptions { Arrear	6	0	0			
				140	0	0
To Sale of Tickets				2	19	6
				£475	15	9

1881-82. Cr.	£	s.	d.
By Advertising, Printing and Stationery	50	18	1
By Lecturer's Fees	10	0	0
By Hire of Room and Expenses in Connection with Lectures	11	0	0
By Printing Transactions	57	10	9
By Clerical Assistance to Secretary and Treasurer	40	3	0
By Rent of Room in Mutual Buildings	23	0	0
By Fees to Collector of Subscriptions 5 p. c. on £136	6	16	0
By Attendance and Petty Expenses	13	18	7
	213	6	5
By Balance as follows:			
Fixed Deposit 200 0 0			
Bank Balance 63 3 5			
Petty Cash Balance 1 5 11			
264 9 4			
Less cheque outstanding 2 0 0			
	262	9	4
	£475	15	9

CAPE TOWN, 20*th July*, 1880.

C. ABERCROMBIE SMITH, *Hon. Treasurer.*

We, the undermentioned members of the South African Philosophical Society, do hereby certify that we have examined the above account, compared the cash payments with the vouchers, and the balance with the Bank Pass Book, and find the same to be correct.

FRED. F. RUTHERFOORD, C. R. EATON, } *Auditors.*

ANNUAL ADDRESS TO THE MEMBERS

OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

ON WEDNESDAY, JULY 26, 1882,

BY THE PRESIDENT, JOHN G. GAMBLE, M.A., M. INST. C.E.

THE BAROMETER AND THE WINDS.

I. INTRODUCTION.

LADIES AND GENTLEMEN,—I propose in this address to give you some account of the connection between the direction and force of the wind on the one hand, and the height of that useful but much misunderstood instrument the barometer on the other.

To my scientific friends I must apologize for taking them along well-known paths; however I trust they will excuse me, when they consider the importance of spreading more correct ideas on the subject. It is a subject intimately connected with the objects of our Society, for it is one in which there is much need of investigation and research here in South Africa.

In meteorology, as in most subjects that we attempt to treat scientifically, we may trace the steps by which knowledge has been increased, but this, though an interesting pastime and perhaps useful as a study of the education of humanity, is not of much profit from a scientific point of view.

We must travel very far down the stream of time before we can get clear of the sandbanks of metaphysics, or can find a sufficient depth of positive knowledge to float the bark of accurate science securely on its onward course.

The treatises of Aristotle, Theophrastus, Seneca and Pliny contain some superficial observations amid an enormous amount of absurd speculation. The middle ages added nothing; one writer declared that the oblique motion of wind was caused by the energy of angels. The college of Coimbra said that wind was caused by the immediate influx of the Divine power, and the great Kepler, from whom better things might have been expected, "will," as an old writer* puts it, "needs have the

*Bohun. Fellow of New College, Oxford. Discourse on the Origin and Properties of Wind. Oxford, 1671.

earth animated and breathe out winds from the subterraneall caves as from its nostrils or mouth." This reminds us of our own Milton, who writes :

> Nor slept the winds
> "Within their *Stony Caves* but rush'd abroad,
> From the four hinges of the world and fell
> On the vext wilderness."
>
> *Paradise Regained IV.*, 413-416.

2. The Barometer.

The first step by which any positive advance was made was the discovery of the principle of the barometer by Torricelli, pupil of Galileo.

One notable and great difference between the barometer and some other instruments is that the barometer gives us information as to the weight of the whole column of air from the instrument to the limit of the atmosphere, while the thermometer only tells us the heat of the air in immediate contact with the instrument, and a few yards off the temperature may be very different.

The barometric column is a pressure gauge or balance : it measures the weight of the column of air immediately above our heads at the moment of observation. This it gives unerringly.

Ignorant people may frequently be heard to say, "Oh, you cannot depend upon the barometer in this climate." I need scarcely tell the present audience that such language is ridiculous, The barometer, if it is a good instrument and in order, gives the weight of the atmosphere as accurately at Cape Town as at Greenwich, on the banks of the Vaal as on the banks of the Seine. It is their *inference* from the barometric reading that is incorrectly made. The foolish inscriptions which are printed on some barometers have no doubt misled many. The words "fair," "change," "rain," to correspond with high, mean and low barometric columns respectively, are no doubt found to suit fairly well for Western Europe, at or near sea-level : but they are only the results of the observation that such weather in those places generally follows from such heights of the barometric column. In other parts of the world other inferences must be made ; for example, at the mouth of the River Plate a falling barometer indicates fine weather, a rising barometer the reverse. The meteorologist in South Africa must remove those delusive words from his "glass," and, by means of his own observation, endeavour to lay down a law for his own neighbourhood.

Yet a single barometer, valuable as it is, tells us very little of weather, and, as I shall show further on, we must have several barometers distributed at suitable distances apart.

The column of material, which in the barometer balances the column of air, will of course be shorter and more convenient the heavier the material we select. This is one reason why mercury has been chosen, but other substances have been used. Water barometers have been made, and at present in one of the London newspaper offices a column of

erine is used. The column of glycerine is twenty-seven feet high n the mercury is thirty inches.

The want of portability of a column, even of mercury, has made it rable to use other gauges for estimating the weight of the atmosphere. e most common of these is the aneroid. The essential part of an roid is an air-tight drum of thin corrugated metal, from which drum air has been partially exhausted. The atmospheric pressure s on the sides of this drum, and the amount to which the sides forced in measures the pressure. This amount is made visible by chanism.

An aneroid is a very sensitive weather gauge, but its index is liable be shifted by shakes or jolts or other causes, so that an aneroid should quently be compared with a mercurial barometer. In order to com- re the two instruments the mercurial must be reduced to a standard mperature. The aneroid reading need not be so reduced because akers endeavour, with more or less success, to compensate the echanism of aneroids for the expansions and contractions due to anges of temperature. The temperature chosen is 32° Fahrenheit or ezing point, that is to say, the barometric reading must be reduced to hat it would have been if the instrument and mercury in it were lunged in melting ice.

Another caution I would venture to give to those who use aneroids or ther barometers is that in ascertaining heights by their aid you must ot omit to observe the temperature of the air. Supposing I have two neroids set to read together, and I observe one of them on Table Mountain to read twenty-seven inches, and my friend simultaneously bserves the other at sea level to be thirty inches. Then I know that he weight of the column of air between the levels of the two places is qual to the weight of three inches of mercury at 32° Fahrenheit, but I annot tell how many feet of air three inches of mercury at 32° F. correspond to, unless I know the temperature of the air. Air expands with heat, and on a hot day three inches of mercury would be equivalent to a much greater number of feet of air than on a cold day. Some aneroids have a feet of air scale placed round the inches of mercury scale; these are generally marked for an air temperature of 50° F., but as we in this country seldom have a temperature in the daytime as low as 50° we must in general add to our aneroid reading.

The fluctuation of the barometric column in the daily and yearly periods is a feature which must not be neglected. During the twenty-four hours the atmospheric pressure has two maxima and two minima; the maxima occurring about ten a.m. and ten p.m., the minima about four p.m. and four a.m. There is also a fluctuation in the yearly period, the pressure being greater in winter than in summer. I heard of an African traveller who noted his aneroid reading at sea level on Port Elizabeth beach and gave the heights he subsequently read up-country, without any inkling that a correction was necessary. If his sea-level reading was taken on a summer afternoon most of his altitudes would be on that account too high; had he read at sea-level on a winter morning they would be too low.

I may note here in passing that Sir William Thomson has recen noticed a curious effect of the daily variation of pressure.* The incre mass of the atmosphere occurring at ten a.m. or two hours before place of observation reaches the meridian, the attraction of the sun this increased mass will tend to accelerate the earth's rotation. That taking the simple case of the sun being in the plane of the equator, sun's attraction on this increased mass may be resolved into two co ponents, one acting in the same line but in an opposite direction gravity, the other in the same instantaneous direction as the earth rotation. He estimates this acceleration to be about one-tenth of t tidal retardation.

3. The Winds.

To pass on to the winds. Wind is of course air in motion. B what causes the motion? Bacon said "Sol est genitor ventor præcipuus" (The sun is the chief producer of winds).† Had he said t sun is the *only* producer of winds he would have been right. And n merely the sun but the sun's heat is the only appreciable cause of wind Some indeed, great authorities in other branches of knowledge, ha maintained that the attraction of the sun and moon, which as you kno causes the tides of the sea, is also the cause of the winds of heave The great mathematician D'Alembert,‡ in an essay which won a pri offered by the Royal Academy of Sciences of Berlin, maintained th importance of attraction. D'Alembert indeed acknowledges that the are other causes which change and even mask the attraction of the su and moon, but he regards attraction as the chief. But subsequen research does not support this view. Laplace devoted a chapter of th *Mécanique Céleste* to an examination of the oscillation which the attrac tive force of the moon is capable of producing in our atmosphere. He chose the moon alone because the attraction of the moon on the earth is considerably greater than that of the sun, and if we can show that the moon's attraction is inconsiderable we can of course infer that the sun's is inconsiderable likewise. Besides, by confining our attention to the moon we can consider the question irrespective of the action of the sun's heat, the reflection of heat by the moon being inconsiderable. Laplace found, after discussing a long series of observations, that the effect on the barometric column is not greater than one-thousandth of an inch of mercury. And Herschel gives the limit by pointing out that, inasmuch as attraction varies as the mass of the object attracted, the attraction of the sun and moon cannot cause any greater difference of height in the atmosphere than they do on the water in the open ocean, namely, six feet or 1-130th of an inch of mercury. In fact attraction is very slight compared with heat, and until meteorological knowledge is very much more advanced it may practically be neglected.

*Paper read before Royal Society of Edinburgh, noticed in the *Engineer* 3rd March, 1882, p. 157.

†Bacon, Lord. De Ventis. Best edition, Ellis and Spedding.

‡D'Alembert. Reflexions sur la cause générale des Vents. 4to. Berlin. Haude and Spencer, 1747.

4. The Sun's Heat.

The sun's heat is the only appreciable cause of wind, and I must erefore trespass on your patience while I endeavour to explain the tion of the sun's heat. The sun's heat acts differently on dry air, on pour, on water and on land; hence it disturbs the equilibrium of e atmosphere, and this disturbance gravitation tends to restore.

Transfer of heat is effected in three ways: conduction, convection d radiation. Conduction is the transmission of heat from particle particle, as when one touches a hot substance the hand becomes arm. Convection is the motion of the particles themselves, of liquids gases. Thus if a lamp is lighted the particles of air that have een heated rise up, forming what are called convection currents, and older air flows in below to take their place. Radiation is understood s that transfer of heat which takes place from any body to any cooler ody at a distance from it. You may stand in the sun on a cold day nd be warmed by the radiant heat of the sun. Go round to the shady ide of the house and you will feel cold, for your body instead of receiving heat as before will be giving it up or radiating it to bodies around.

It is somewhat difficult to explain how the heat passes. It is generally held by scientific men that heat comes in waves of an unknown substance more delicate than air. These waves are simply movements of form like those which one can make in a rope when one end is fixed to a post and the other end held in the hand. By raising and lowering the hand when the rope is slack waves can be sent along the rope from the hand to the post, but these waves are movements of form only, the particles of hemp remaining nearly at the same distance from the hand during the experiment. This wave theory of light and heat is what is called a working hypothesis, it cannot be rigorously proved but it is accepted provisionally, for it not only helps us to account for observed phenomena but it frequently enables us to predict other phenomena not actually observed.

The heat of the sun is received first by the atmosphere, which consists mainly of dry air and watery vapour, and secondly by the surface of the earth, consisting of land and water. 99½ per cent. of the atmosphere is dry air, and nearly all the remaining half per cent is watery vapour mixed up with the air. Dry air gets very little of its heat by direct radiation from the sun, the rays pass through dry air without warming it; nor does it get much by the radiation of dark heat from the earth; the dark rays also pass through it, but it gets most of its heat by convection currents among its own particles, the lowest stratum being heated by conduction from the earth's surface. Generally and roughly speaking it is the ascending current over the hot portion of the earth that causes the cold surface-indraught of the trade winds. The action of heated air has generally been recognised, but it is to the action of heat on vapour, which has been only recently appreciated, that we may look for the explanation of many, if not of most, meteorological phenomena. Watery vapour acts in three ways: (i) it is lighter than air, and therefore when formed it has a tendency to rise and carry

up particles of air with it. (ii) When it is condensed into cloud or rain heat is developed, or, to put it more in accordance with scientific phraseology, the potential energy of molecular position of the vapour held in the air is changed into the actual molecular energy of heat. (iii) Watery vapour has an extraordinary power of absorbing the dark rays of heat radiated from the surface of the earth.

In respect to the absorption of the earth's heat by watery vapour, I venture to quote the following remarks by the great experimentalist who has established so clearly this phenomenon, Professor Tyndall :—

"No doubt can exist of the extraordinary opacity of this substance to the rays of obscure heat : particularly such rays as are emitted by the earth after being warmed by the sun. Aqueous vapour is a blanket, more necessary to the vegetable life of England than clothing is to man. Remove for a single summer-night the aqueous vapour from the air which overspreads this country, and you would assuredly destroy every plant capable of being destroyed by a freezing temperature. The warmth of our fields and gardens would pour itself unrequited into space, and the sun would rise on an island held fast in the iron grip of frost. The aqueous vapour constitutes a local dam by which the temperature at the earth's surface is deepened ; the dam, however, finally overflows, and we give to space all that we receive from the sun."*

Tyndall has recently compared the heat and light given by the sun with the heat and light given by the electric arc.† He says the obscure radiation from the electric arc is eight times as great in heating power as the luminous radiation. That is to say, if you pass the rays through a prism so as to separate the rays of different wave-lengths, then you will get eight times the heat by screening off the light-giving rays and only using the dark rays at the red end of the spectrum that you would get if you screened off the dark rays and only used the luminous rays. But in the case of the sun he finds that the dark rays only give twice the heat that the luminous rays give. Now by placing a layer of water in the path of the electric light its radiation becomes very much like that of the sun. The inference from this is that it is the aqueous vapour in the atmosphere, through which the sun's rays must pass in order to reach us, which absorbs the dark rays. And this is verified by observations made by an American professor on a mountain in California twelve thousand feet above sea-level, for this observer says he finds at that height an enormous expansion of the ultra-red spectrum.

Tyndall has also recently shown a curious experiment by which the absorption of heat by vapour can be *heard*.‡ He passes impulses of light very rapidly succeeding each other into a flask containing vapour. This is done by making the rays pass through holes in a rotating disc. When the vapour receives these impulses, vibrations are set up, and sounds given forth which can be conveyed to the ear by an indiarubber tube fitted to the mouth of the flask. Vapours that let heat pass through

*Tyndall. Heat as a Mode of Motion. Ed. 3. 1868, appendix to chapter xi.
†Lecture at Royal Institution, 3rd Feb., 1882. *Engineer* 17th Feb., 1882.
‡ Lecture at Royal Institution, 3rd Feb., 1882. *Engineer* 17th Feb., 1882.

illy give forth faint sounds, those that absorb much heat give out
d sounds.

I have mentioned before that roughly speaking the winds blow to the
regions. But it is by no means everywhere the rule that the wind
s towards the hottest regions. In July the Sahara is probably one
the hottest parts of the globe, but the North-east trade flows away
m the Sahara. It is the action of vapour at the equatorial regions
ich must be studied to answer this problem. To quote Professor
ndall again* :—

"The sun raises the vapours of the equatorial ocean; they rise, but
a time a vapour-screen spreads above and around them. But the
ther they rise, the more they come into the presence of pure space;
d when, by their levity, they have penetrated the vapour-screen,
ich lies close to the earth's surface, what must occur? It has been
d that, compared atom for atom, the absorption of an atom of aqueous
pour is (16,000) sixteen thousand times that of air. Now the power
absorb and the power to radiate are perfectly reciprocal and propor-
nal. The atom of aqueous vapour will therefore radiate with sixteen
usand times the energy of an atom of air. Imagine, then, this power-
l radiant in the presence of space, and with no screen above it to
eck its radiation. Into space it pours its heat, chills itself, condenses,
nd the tropical torrents are the consequence. The expansion of the
r no doubt also refrigerates it; but in accounting for deluges, the
lling of the vapour by its own radiation must play a most important
rt."

Some people have asserted that, when vapour is condensed into cloud
r rain, a vacuum is caused, and that, in consequence, wind arises from
r coming to fill up the vacuum. This is not so. The fact, on the
ontrary, is that the increase of volume in the air by the added heat is
ore than five times the lessening produced by the disappearance of
aterv vapour. It is the increased rarefaction caused by the developed
eat that gives rise to the ascending current, and hence to the surface
ndraught of the trades.

With regard to the different action of heat on land and on water. Land absorbs heat quickly and radiates it quickly, water absorbs it slowly and radiates it slowly. This is the reason why sea-side places have a later summer, and a later winter, than inland places. This is also the principal cause of the phenomenon known as "land and sea breezes." Under the cloudless sky of a summer day the land often reaches the temperature of 120° F. The sea is rarely more than 80°. There is therefore an ascending current over the land, and the heavier air over the sea flows in, forming the *sea-breeze*. At night the land radiates or cools very much faster than the sea, especially if the sky be clear and the air dry. The air over the land therefore becomes colder and heavier than that over the sea, and consequently flows seaward, causing the *land-breeze*. The land and sea-breezes are experienced generally in the tropics and occasionally in higher latitudes. They are as constantly expected in

* Tyndall. Heat as a Mode of Motion. Ed. 3, 1868, appendix to chapter xi.

low latitudes as the sun himself, and seldom fail except in the rainy season.

Time does not admit of my going further into the action of heat, but we may sum up in the words of the eminent American Ferrel.* "There can be no winds without a disturbance of static equilibruim by means of a difference of temperature or of aqueous vapour in different parts of the atmosphere." And we may add that there is no other cause than the sun's heat that can give sufficient differences of temperature and humidity to cause important winds.

5. The Earth's Rotation.

I say that the sun's heat is the only appreciable cause of wind, but there is a factor which affects the direction of wind though it does not cause it:—the earth's rotation about its axis. If you propel a particle in any direction on the earth's surface, the tendency of the earth's rotation is to make the path of the particle relatively to fixed lines on the earth's surface deviate to the right in the northern hemisphere and to the left in the southern hemisphere. This is owing to the surface velocity lessening as the latitude increases. The surface velocity at the Equator is seventeen miles a minute, in latitude 60° it is only eight and a half miles a minute. This would make it appear that the relative velocity of the particle that had moved from the Equator to latitude 60° without friction is 8½ miles a minute. Ferrel has shown that it is really three times this, as will be seen from the following consideration. The particle moving from the Equator towards the pole gets nearer its axis of rotation, therefore, by the principle of the conservation of areas, it will revolve at double the velocity at latitude 60°, that is at 34 miles a minute, so that its relative velocity is 25½ miles a minute.

So a particle starting from the latitude of "the Cape" with direction North has of course the velocity of particles at "the Cape" as well as any impressed velocity given by the cause that moves it away from its place of rest. Let us neglect friction and consider the path of the particle. As it gets nearer the Equator it comes to places that have a quicker velocity than it has, it has also moved farther away from its axis of rotation, it thus cannot keep up and lags behind, hence its apparent motion as seen from the earth is not merely from the South, as it would be if the earth were at rest, but from the South and East together. This is the phenomenon of the South East trade. The radius of any parallel of latitude is proportionate to the cosine of the latitude. The acceleration of relative velocity is due to the difference between the radii of consecutive parallels, and is therefore proportionate to the fluxion of the cosine of the latitude, that is to the sine.

This principle seems to have been first discovered by Hadley in 1735, who discussed it in a paper read before the Royal Society and published in the Transactions. At a later period Deluc† and subsequently the great

* *Nature*, 4th May, 1882, p. 11.

† Lettres physiques, t. 5, part 2. 1779 let. cxlv.

erman philosopher Kant* stated it, both apparently thinking that they ere the first discoverers. Kant says :—"This rule, which 'so viel ir wissend ist' (as far as I know) has never yet been noticed, may be garded as a key to the general theory of the winds."

6. Geographical Distribution of Land.

The geographical distribution of land also clearly affects the direction f wind. The continents of the world become more heated by the sun's ays in summer and more cooled by radiation in winter than the sea in he same latitudes, hence the wind will tend to flow in towards the land n summer and out from it in winter. This is clearly an extension to he yearly period of the phenomenon of land and sea breezes in the daily period. The monsoons of the Indian Ocean are an example of this, the North-east monsoon of the Bay of Bengal in winter times is simply the trade, but the South-west monsoon that brings the rain to Hindostan is the trade reversed, or diverted, towards the ascending current over heated Asia.

Land also acts in other ways on the wind : as an obstacle it turns or checks the wind. Thus along the Peruvian and Chilian coast, where the chain of the Andes is close to the sea, the wind is almost always along shore. So, too, in valleys the wind is either up the valley or down the valley, and the same is found in straits. The strength of wind becomes less as it passes from the coast to the interior. This has been clearly shown in England, and also by the careful observations of Mohn in Norway and Sweden. It is also to be observed in South Africa, the velocity of the wind being much greater near the coast than inland. Balloon observations show that, generally speaking, the wind is stronger in the upper regions of the air than it is at the surface.

Thus there are three important factors, the sun's heat, the earth's rotation, and the geographical distribution of land and water.

7. Electricity.

Before proceeding further I would allude to that "Deus ex machinâ" of many a puzzled meteorologist, electricity. There is an undoubted connection between magnetic and meteorological phenomena. Padre Secchi says that at Rome meteorological disturbances are generally one day behind the magnetic. And Professor Balfour Stewart thinks it may ultimately be possible to forecast British meteorological weather by means of magnetic variations some five or six days previous.† There does not, however, seem to be any reason for supposing the magnetism to be the cause of the meteorology. They are probably rather concomitant effects of the same cause, the sun's heat. In smaller phenomena electricity is apparently rather the effect than the cause of atmospheric disturbance, just as we see that electricity is generated by the blow-off pipe of a steam engine.

*Immanuel Kant, physische Geographie Bd. iv.—Dritte anmerkung zur Erläuterung der Theorie der Winde. Vollmer. Mainz und Hamburg 1805.

†*Nature*, vol. 24, p. 8.

8. Anemometers.

Though we can measure the weight of the air very accurately we have great difficulty in measuring the force of the "swift-winged breezes." There are two chief kinds of anemometers in use; one measures the *velocity* of the particles of the air, as the "Robinson," the other measures the *pressure* on a surface of given area, the best of which kind is perhaps the "Osler." For general meteorological purposes the number of miles travelled by the wind is more important. For engineering problems the force with which wind presses against a structure is required. One objection to the Robinson anemometers is that the large instruments always show more movement of the air than the small ones! This was noticed by Mr. Blanford, meteorological reporter to the Government of India, and it has recently been found markedly the case by our Vice-President, Dr. Gill, who has fixed a large anemometer on the Royal Observatory adjacent to a small one of the usual pattern. I have no doubt he will communicate to the Society the results of the comparison. It is very difficult to find suitable places for fixing anemometers, and experiments are much needed. As to the extreme force, Mr. R. H. Scott, director of the Meteorological Office, London, says that, during gusts, the wind is travelling at the rate of one hundred miles an hour. But this has been exceeded in West Indian hurricanes. Till quite lately wind force has been estimated by what is called the Beaufort scale, which refers to the quantity of sail that a vessel can carry with each wind. But this method has been found so unsatisfactory that, on the wind charts published by the Board of Trade and on those published by the Admiralty, the force of the wind is entirely neglected and only the frequency taken into consideration.

9. Buijs Ballot's Law.

Having now considered the instruments used in observing as well as some features of the phenomena, and also apparent causes of the phenomena, we are in a better position to grasp the one great law or rather generalization of Meteorology. This law we owe to a Dutchman, Professor Buijs Ballot, director of the Royal Meteorological Institute of Utrecht. We may briefly state this law as follows:—

"Turn your back to the surface wind, and if you are in the Northern Hemisphere you will have the lowest barometer to your left hand, if you are in the Southern Hemisphere you will have it to your right hand."

This law had previously been known to be true of tropical hurricanes, and Dr. Lloyd in his Meteorology of Ireland notices that it is true in Western Europe, but it was Buijs Ballot who first stated the law for winds in general, and it is by his name that the law is generally known.

The continued study of weather charts has caused the law to be stated in the following extended form:—"The wind blows round and in upon an area of low pressure in a direction against that of the sun in azimuth in both hemispheres; that is, against watch-hands in the Northern hemisphere and with watch-hands in the Southern hemisphere."

The system formed by an area of low pressure with the winds blowing round and in upon it may be called a *cyclone*; areas of high pressure on the other hand are called *anti-cyclones*, and the wind blows out from these and round them in the opposite direction to that in which it blows round low pressure areas.

This statement of the law introduces a new feature; that is, the spiral motion of the wind. The wind does not merely blow *round* an area of low pressure but *in* upon it as well. It also blows *out* from and round an area of high pressure.

Every wind is thus a portion of a cyclone, or of an anti-cyclone, and here we may note that the author of the book Ecclesiastes seems to have appreciated this cyclonic movement. The authorized version does not give it so markedly as the Septuagint:—

"πορεύεται πρὸς νότον καὶ κυκλοῖ πρὸς βορρᾶν, κυκλοῖ κυκλῶν πορεύεται τὸ πνεῦμα καὶ ἐπὶ κύκλους ἀντῶν ἐπιστρέφει τὸ πνεῦμα."

Ecclesiastes i. 6.

which we may render literally:—

"The wind goeth towards the south, and circles round to the north, circling it circles as it goes, and the wind returneth upon its circles."

The most convincing proof of the truth of Buijs Ballot's law is obtained from examining the charts of winds and isobaric lines for each month drawn by the Scotch meteorologist Alexander Buchan. He has calculated the mean monthly pressure for 516 places, the direction of the wind for 203 places.

These maps accompanied a paper read before the Royal Society of Edinburgh, and were engraved and bound up with its transactions. Buchan has since published a handy book and an introduction to meteorology, both giving some of the maps, but such are the deplorable imperfections of the South African Public Library that neither the Transactions of the Royal Society of Edinburgh nor the hand-books of Buchan can be found on the shelves of that institution, and in order to make wall diagrams for this address I have been obliged to take these maps from those in a German work "Peschel's Physische Erdkunde," of which I happen to possess a copy. Peschel's maps are mainly founded on Buchan's. This has involved transforming back again the readings from millimeters to inches. The maps, as you see, are on Mercator's projection; the red lines are isobars, that is, are drawn through places where the barometric reading reduced to sea-level stands at the same height. These lines are thus drawn on a similar principle to the isothermal lines first drawn by Humboldt, the barometric readings being used instead of the thermometric.

Some months ago I was able to bring before the Society drawings of isotherms of South Africa. Unfortunately barometric observations have been hitherto so few and so faulty that I am as yet unable to draw isobars of South Africa, though I hope soon to be in a position to do so.

In these maps Mr. Buchan has as far as possible chosen observations from stations near sea-level, because, as he says, "the manner of geographical distribution of the pressure doubtless varies at different heights." Mr. Buchan reduces his means to 32° F., and in order to correct for

daily range he chooses, where practicable, hours when the pressure is equal to the mean of the day. Where this is not practicable he corrects the reading by aid of hourly observations taken elsewhere. Having thus got rid of all possible sources of error, he draws arrows giving the mean direction of the wind for the month under consideration, neglecting force for reasons I have already mentioned.

Mr. Buchan finds as the broad results of his investigations that there are low pressures over the continents in summer and high pressures over the same in winter; and that in winter, when there are high pressures over Asia and America, there are low pressures over the North Atlantic and the North Pacific.

We notice that the winds blow round and in upon the areas of *low* pressure, round and out from the areas of high pressure, in accordance with Buijs Ballot's law. Thus there is an area of *high* pressure over Asia in *winter*, and we have the winds on the Western side blowing from the Southward, and the winds on the Eastern side from the Northward; the North-east monsoon being then prevalent in the Bay of Bengal. I may note that this high pressure is due to cold, which is due to dryness, the radiation from the earth going on unchecked by the absorption of vapour. In *summer* these conditions are reversed: there is an area of *low* pressure over Asia, the wind blows from the Northward in Palestine, the South-west monsoon replaces the trade, and the wind in the China Seas is from S.E. So of the North Atlantic in winter we have N.E. in Greenland, N.W. in Hudson's Bay, W. in the United States, W.S.W. on the Atlantic, S.W. in England and France, S. at St. Petersburg, S.S.E. at Hammerfest in the extreme North of Norway.

In both North and South Atlantic there are high pressure areas at the tropics both in summer and in winter, and it will be observed that the wind blows round and out from these areas in accordance with the *law*.

Buijs Ballot's law is thus true of the areas of maximum and minimum pressure for the different seasons. It is also true of the lesser cyclones and anti-cyclones, which in temperate latitudes are continually travelling and changing as they travel. A very cursory examination of the charts published in the English papers is sufficient to prove this.

We can not only predict the direction of the wind by aid of Buijs Ballot's law if we know the pressure at a number of stations, but we can tell the relative force of the wind. If the isobars are close together, showing a considerable difference of pressure at adjacent stations, then the wind is strong, and *vice versâ*. Mr. Stevenson proposed the term "barometric gradient" for the ratio of the difference of pressure between two places to their distance apart. This term is now generally accepted, and has been of much service.

When it is found that Buijs Ballot's law does not apparently hold good of any particular case, we must not necessarily jump to the conclusion that the law is not true. In the case of light winds, local causes, such as the proximity of hills and valleys, often overpower the main stream; eddies frequently exist just as they exist in rivers; moreover at places high above sea-level a current of air often prevails different to that which is found on the plain below.

10. Upper Currents.

The question may now be very pertinently asked, if the wind blows in upon an area of low pressure what becomes of it? Does it merely serve to make up the deficiency of pressure and to re-establish the balance? No, the air goes on blowing in upon an area of low pressure in much greater abundance than would be sufficient to make up the equilibrium. And also of the high pressure, if the wind continually blows out from an area of high pressure whence is the supply kept up? There can be but one answer, namely, that it is by upper currents.

We know that there are upper currents, and that they frequently blow in an opposite direction to the wind below. High up on the peak of Teneriffe there is often a westerly wind when the N.E trade is blowing strongly further down. In England we often see cirrus clouds floating along from the S.W to the N.E. while the wind at the surface is from the east. As a rule we only know of the existence of those upper currents which are damp enough to carry along moisture in the form of cloud with them, but even with regard to these observations are very much wanted in South Africa. For the dry upper currents we depend almost entirely on the observations made from balloons, though we have occasionally obtained such evidence during volcanic eruptions, the ashes having been carried a long distance in an opposite direction to the surface current.

The air that swirls round and in upon an area of low pressure rises up as an ascending current, not actually in the centre, perhaps, but more or less so. The air-particles will go on ascending as long as the pressure in the space around is greater than in the column at the same level. As soon as they reach a height where the pressure is less they flow over and go to feed the areas of high pressure where air has been abstracted below. Thus a vertical circulation is kept up. An illustration of this may be noticed on the sea-shore where land-springs come out under the sea-water. The fresh water being lighter than the salt rises to the top, piles up, as it were, and then runs away down hill over the salt.

The Rev. Clement Ley, a practical meteorologist who has made upper currents his special study for years, thus enunciates the law in reference to them for the Northern hemisphere. "The highest currents of the atmosphere, while moving commonly with the highest pressures on the right of their course, yet manifest a distinct centrifugal tendency over the areas of low pressure and a centripetal over those of high." That is to say, the upper currents blow out from and round an area of low pressure, and in upon and round an area of high pressure, exactly the opposite of what the surface currents do.

11. Storms.

With regard to Storms we may say that all storms are cyclonic or vorticose because all winds are vorticose, and storms are only more violent winds caused by a steeper barometric gradient. Storms may, especially in temperate latitudes, seem rectilineal because the vortices are so large,

and wind of extreme force only occurs over a small arc of the spiral curve round the centre of barometric disturbance.

Storms may thus be divided into (i) those in which a violent wind is experienced round the whole circuit about a barometric minimum. These are cyclones commonly so called, and embrace West India, Mauritius and Bay of Bengal hurricanes as well as the Typhoons of the China Seas. (ii) Those which only occupy a portion of the curve round an area of low pressure. This is the character of most storms in temperate latitudes. The area of low pressure may be a fixed one in which case there is no veering or backing of the wind as is the case with trade wind gales; or the low pressure may have a path of its own as with most storms of temperate regions, in which case there will be generally veering or backing.

Though time will not permit me to describe storms in general, yet the path of storm-centres is a subject which has been carefully watched of late years and to which I should like to call your attention. The paths of West India hurricanes have been carefully traced, they have a parabolic form with an area of high pressure between the Azores and the Bermudas more or less in the focus; Mauritius cyclones have a similar path, though being in the Southern hemisphere the direction of motion round the high pressure area is the opposite of what it is in the Northern hemisphere. It is, however, in regard to the path of European storms that so much investigation and research has been applied of late years. European storms are for the most part first experienced in the Atlantic and travel to the East over Europe. Storms have been traced the whole way from the United States. The storm in which the turret-ship *Captain* foundered came from Nova Scotia. Of this kind is the series of storms depicted in the wall-diagrams. These storms occurred last October, and the diagrams are enlargements of charts published by the Meteorological Society of England. The principal cyclone was also discussed in Germany and traced as far as the White Sea, but I have not been able to obtain the charts. The number of feathers in the arrows indicates the force of the wind. As will be seen, there is a series of five cyclones which follow one another across the Atlantic. On the 9th of October, No. I is at the Southern point of Norway, No. II is off Newfoundland. On the 10th, No. I has proceeded to the North of Norway, No. II has got to mid-Atlantic, and a No. III has appeared at Halifax. On the 11th, No. I has disappeared from our chart, No. II has got to the North of Shetlands, and No. III has made some progress Eastward. On the 12th, No. II has got a little nearer to Norway, No. III has advanced to the North-east. On the 13th, No. II is just disappearing from our chart, No. III is approaching the West of Ireland, a No. IV has appeared to the Westward of the Azores, while a No. V shows itself on the St. Lawrence. On the 14th, No. III, which is clearly the worst hitherto, is off the Firth of Forth, and there are very violent N.W. winds over Ireland and very violent S.W. over England, while there is a furious gale from the N.E. at Aberdeen. No. IV has come further East and No. V has got to the South point of Newfoundland. It is storm No. III which, as I have said, was traced as far as Archangel. You will note

at there is a high barometer pressure at the Azores throughout the hole of the time under consideration, but the pressure decreases very uch between the 9th and 14th.

Many storms instead of going to the north of Norway take a more outhward course over Europe. Padre Secchi says that most of the reater storms which appear in England or Scotland are felt at Rome bout two days after. He says that the greater part of these two days employed in traversing the Alps.*

It is the investigation of these tracks that enables storm warnings to e issued. Storm warnings were started rather more than twenty years go by Admiral Fitzroy in England and by Leverrier in France, but the umber of reporting stations was hardly sufficient and the results were not remarkably good. The storm warnings were discontinued for a time, though the telegraphic reports on which they were founded were still sent. Of late years there has been much improvement. The London Meteorological Office receives telegraphic reports from 53 stations ranging from the Arctic circle to the coast of Spain. Storm warnings are being issued again, and it is a gratifying result that ⅔ths of the predictions have been successful, and that there has been a steady reduction of the number of wrecks on the British coasts since warnings were sent north.

The question of Predictions is certainly a very intricate one, as Mr. N. Hoffmeyr, of Copenhagen, has pointed out. That eminent Danish meteorologist says that sixty-one per cent. of the storms experienced in western Europe come from the American continent, the remaining thirty-nine per cent. originating on the Atlantic itself; moreover a large proportion of storms disappear before reaching Europe, so that the warnings sent by the *New York Herald* for some time past are not infallible. By receiving reports from ships arriving in the United States they may occasionally warn Europeans of a storm that has arisen at sea, or may know of the dissipation of some storm that has passed over America; but they are as yet unable to predict which of their cyclones will die away on the Atlantic; which pass on with diminished gradients so as to be harmless; which will continue with hurricane force to the shores of the old world.

The question will no doubt be asked, why do the cyclones move in these paths? Ferrel has well shown that every cyclone has an inherent tendency to go polewards, because as the deflecting force due to the earth's rotation varies as the sine of the latitude, the deflecting force will be greater on the polar side of a cyclone than on the equatorial side. That is, the east wind on the polar side of a cyclone has more tendency to deviate polewards, than the west wind on the equatorial side has to deviate equatorwards. I say polewards and equatorwards because the principle is of course equally true of both hemispheres. Besides this feature there is another, namely, that a cyclone, when it is generated, like a whirlpool in a river, partakes of the general movement of the atmosphere.

*Bulletino Meteorologico dell' Osservatorio del Collegio Romano. 31 Gennaro 1867.

Ferrel thus explains the parabolic path of North Atlantic storms. In the trade wind latitudes the wind at the earth's surface is from East to West, hence the cyclones are carried to the West, but having a tendency towards the pole they also go to the North. The combination results in a motion towards W.N.W. As they pass northwards they get out of the trade wind region and their course is more or less North. They then get into "the brave west winds" and their path is towards the East.

12. Anti-cyclones.

The barometrical maxima or centres of anti-cyclones are much more stable than the cyclones or minima. They are generally accompanied by calm, cold, bright weather in winter time; they are not so well marked in summer time, but generally accompany fine hot weather. Their outlines are not usually of such regular curves as those of cyclones.

13. Necessity for Co-operation.

Meteorologists suffer under considerable difficulty from the fact that they are so mixed up with the phenomena that they cannot observe them properly. The only chance is to obtain a number of simultaneous observations spread over considerable areas. The President of the Royal Society, Mr. Spottiswoode, says:—"Local weather has been discovered to be contingent upon travelling areas of disturbance each of which averages many hundred miles in diameter, while at the present time, the relation of these areas to one another as parts of a single terrestrial system has become a prominent topic of enquiry. If meteorology has thus been to a certain extent rescued from the ever-accumulating chaos of numerical tabulations, which threatened to engulf the whole science, the improvement is mainly due to the development in recent times of the synoptic study of weather over large regions of the earth's surface."*

General Myers, the eminent meteorologist of the United States, whose recent death is a great blow to science, thoroughly appreciated this, and instituted the formation of daily weather charts embracing a considerable portion of the globe. The London Meteorological Office is about to undertake the preparation of daily weather charts of the North Atlantic ocean for the thirteen months from the 1st of August, 1882, to the 31st of August, 1883. They invite co-operation from all sides, and no doubt will be able to make very much more complete maps than any published hitherto.

In the Southern hemisphere there is even more chance of discovering the laws, because the interference of land-masses is less. Good work is being done in Australia and New Zealand, and South Africa must not be behind hand. I believe that, if we properly interpreted the barometric and wind records at Cape Peninsula, Cape L'Agulhas and the Western stations, we ought to be able to send storm warnings to Port Elizabeth and East London.

* *Nature*, 2nd December, 1880.

We want self-registering instruments, and I am glad to say that arliament has this year given the Meteorological Commission a small te towards the procuring of some. Professor Wild says that two ars observations of self-registering instruments at Berne Observatory id given more information than the previous twenty years ordinary servations. It is as much as we can do to get two observations a ay from unpaid observers, but we want readings much more frenently than that. The self-recording instruments generally give a ntinuous record on a paper cylinder that moves round by clockwork. here is at present at the Royal Observatory an instrument recording the elocity and direction of the wind. This is very important, for, apart rom the advantage of continuity in the observations, it is not everyone hat can, like Hudibras,

> "Distinguish and divide
> A hair twixt South and South-west side."

Another self-recording anemometer is being fixed at East London, and a third, I believe, is to be placed near Port Elizabeth : but we want besides some self-recording barometers and thermometers, and should have at least six sets distributed throughout South Africa.

We must have co-operation. As has been well said, "a Galileo or a Newton, by the un-assisted workings of his solitary mind, may discover the secrets of the heavens, and form a new system of Astronomy. A Davy in his lonely meditations on the crags of Cornwall, or in his solitary laboratory might discover the most sublime, mysteries of nature and trace out the most intricate combinations of her elements. But the meteorologist is impotent if alone ; his observations are useless, for they are made upon a point, while the speculation to be derived from them must be on space. It is of no avail that he changes his position, ignorant of what is passing behind him and before ; he desires to estimate the movements of space. and can only observe the dancing of atoms ; he would calculate the currents of the atmosphere of the world while he only knows the direction of a breeze."*

Thus wrote John Ruskin some forty years ago. What he taught then is still more necessary now, for the need of co-operation is still more apparent. Then instruments were bad, photography and the electric telegraph were not discovered, the action of vapour on radiant heat was unknown. Now we have made great advances along the whole line of physical science, and in meteorology more especially we have among other things the principle of the absorption of heat by vapour and the law of Buijs Ballot.

But we also want *intelligent* co-operation. We do not want observers who take up meteorology as "an occupation of tedious leisure, or the amusement of a careless hour." We want mechanical minds to work at the improvement of instruments, patient observers to record phenomena, and, more important perhaps than all, we want minds trained to scientific thought to develope from the recorded phenomena the gene-

* Transactions of Meteorological Society, Vol I. 1839.

ralizations they warrant. And if the discovery of those laws come n in our time, or if the search after truth for its own sake require stimulus, let us remember, as John Ruskin* so well expresses it :—

"It is a science of the pure air and the bright heaven ; its thought are amid the loveliness of creation ; it leads the mind, as well as th eye, to the morning mist, and the noonday glory, and the twilight clou —to the purple peace of the mountain heaven—to the cloudy repose o the green valley ; now expatiating in the silence of stormless æther, now on the rushing of the wings of the wind."

JOHN G. GAMBLE.

* Loc cit.

MINUTES OF PROCEEDINGS.

Ordinary Monthly Meeting.

WEDNESDAY, August 30, 1882.

REV. G. H. R. FISK IN THE CHAIR.

Dr. J. J. Kotze, Messrs. Donald Ross and W. Hammond Tooke were duly elected Ordinary Members of the Society.

Donations of books from Dr. Holub, the Sydney Museum, and the Geological Society of Canada, were announced, and the thanks of the Society voted to the donors.

Mr. H. W. Oakley exhibited some specimens of the remarkable *Arthropod* known as the *Peripatus Capensis*. He said it was characterised by the possession of a well-defined nervous system, but the nerve cords, unlike those of most invertebrate animals, were widely separated. It had a very large gland on either side of the alimentary canal, secreting an opaline web-like fluid, which it ejected at any one who handled or otherwise irritated it, the secretion becoming almost immediately indurated: and that the sexes were distinct, and the young were brought forth alive. Mr. Oakley stated that he and his brother found fifty-four specimens, one of which was of a red colour, the usual colour being a velvety black, under stones in some of the gorges of Table Mountain, near Newlands; and also in the decaying woods of the oak, pine and poplar. Although elevated positions were apparently the favoured localities of this curious creature, he had found several specimens on the Rondebosch Flats in the decaying wood of the poplar.

Mr. Oakley exhibited two specimens of the common white-eye (*Zosterops Capensis*). He said his attention was attracted to them by seeing that their throats were of a bright orange colour, instead of the usual yellowish green. Having shot them, it was not until after minute examination that he found the colouring was caused by the pollen of an aloe (*Aloe perfoliata*). He stated that the subject was interesting in two ways, viz.:—In showing how easy it is to mistake a common bird for a rare or new species, and also demonstrating how the aloe is fertilized by birds.

In the discussion which ensued the Rev. G. H. R. Fisk, Messrs. MacOwan, Bolus, Lloyd Morgan, and Dr. Shaw took part.

The Rev. G. H. R. Fisk exhibited some specimens of *serpulæ* a a Penguin's egg, from Robben Island, which was full of sand with any apparent mark of a perforation on the shell.

Mr. Fisk read a list of living specimens, principally *Mollusca* *Reptilia*, sent to the Zoological Society of London, and which had arri well and uninjured.

Mr. E. J. Dunn then read a paper entitled "Some Notes on Colo Coals," at the termination of which the thanks of the Society were vo to him for his interesting discourse.

Ordinary Monthly Meeting.

WEDNESDAY, September 27, 1882.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Dr. Beck and Mr. J. B. Rose were duly elected Ordinary Members of the Society.

Messrs. Trimen and Gamble gave notice that at the next monthly meeting they would move that a special meeting be called to consider the propriety of amending Rule 6 of the Society.

The Rev. Father Perry, S.J., F.R.S. (chief of the British Transit of Venus Expedition to Madagascar), then gave a lecture on "Eclipses of the Sun," which he illustrated by slides and wall diagrams.

At the conclusion of Father Perry's most interesting discourse the thanks of the Society were voted to the lecturer and carried by acclamation.

Ordinary Monthly Meeting.

WEDNESDAY, October 25, 1882.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. Gamble's motion that a special meeting be called to consider the propriety of amending Rule 6, was agreed to.

Messrs. H. Heenan, C.E., of East London, and C. Freeman, architect, of Cape Town, were duly elected Ordinary Members of the Society.

The following donations were announced, and the thanks of the Society voted to the donors :—

Dr. Holub :

"*Separat-Abdruck aus der Augsburger allgemeinen Zeitung.*"

"*Uber eine neue Eremias-Art aus dem Thale des Krokodilflüsses in Transvaal.*"

"*Note sur les figures et les inscriptions gravées dans les roches a El Hadj Mimoun.*"

a Societa Africana d'Italia :

"*Bollettino della Societa Africana D'Italia, Anno* 1, *Fasc. II, Agosto* 1882."

mithsonian Institution :

"*Annual Report of the Board of Regents of the Smithsonian Institution for* 1880."

"*List of foreign Correspondents of the Smithsonian Institution.*"

A letter was read from Mr. E. Pillans, describing a detonating meteor at he had seen.

Dr. Gill gave an interesting account of the Great Comet then visible, d exhibited some photographs of it that had been taken at the Royal bservatory.

Mr. Finlay communicated elements of the comet and pointed out e resemblance they bore to those of the great comets of 1843 and 1880, it he did not consider it a reappearance of either of these comets.

Ordinary Monthly Meeting.

WEDNESDAY, November 29, 1882.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Various donations of books were announced from Dr. Holub, the Department of Mines of New South Wales, and La Societa Africana D'Italia, and the thanks of the Society were voted to the donors.

A paper by Mr. W. B. Tripp, "On the River Buffalo, its Watershed and Flow in connection with the Rainfall," was read by the President.

Special Meeting.

WEDNESDAY, January 31, 1883.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. Trimen moved an amendment of Rule No. 6, viz. :—

"Ordinary members shall pay £2 annually in advance.

"In the case, however, of continuous absence from South Africa for a period of twelve calendar months, an Ordinary Member shall not be liable for payment of subscription during such period of absence, but shall be placed upon the *dormant list* of members until the date of his return.

As regards the Transactions of the Society published during such absence, the absent Ordinary Member shall be placed upon the same footing as a Corresponding Member."

Seconded by Mr. Gamble.

Mr. Lloyd Morgan thought that the practice of Societies in England was rather against this amendment.

Mr. Fisk proposed that the subscription be reduced to £1.

Dr. Shaw moved that the Rule remain as it is.

Mr. Lloyd Morgan seconded.

Mr. Trimen's motion was carried.

Ordinary Monthly Meeting.

WEDNESDAY, January 31, 1883.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Dr. Stevenson, of Rondebosch, Dr. Guild, of Kokstad, and Mr. Potgieter, of Cape Town, were duly elected Ordinary Members of the Society.

Several donations of books were announced from Dr. Holub, and the Department of Mines, New South Wales. The thanks of the Society were voted to the donors.

The President described a new method of rowing by which the oarsman is enabled to look the way he is going, and illustrated the subject by exhibiting some photographs of a specially constructed boat which was used on the Thames last year.

Dr. Shaw exhibited and made remarks on the following, viz :—

(1) Pseudomorph of Calcite after Octahedron Diamond.
(2) Lignite from Cape Flats.
(3) Fossil from Table Mountain Valley.
(4) A Specimen of Dendrites.

Mr. Lloyd Morgan's paper on the "Suicide of Scorpions" was postponed until the next meeting. He exhibited a scorpion which he had forced to inflict a wound on itself, into which it injected its own poison, the same day at 11 a.m., and the animal was still alive.

Mr. Newton (a visitor) exhibited, with a microscope, some examples of multiple staining of vegetable tissues with aniline dyes.

Ordinary Monthly Meeting.

WEDNESDAY, February 27, 1883.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. Noel Janisch, of the Crown Lands Office, and Dr. Herman, of Cape Town, were duly elected Ordinary Members of the Society.

A large donation of books was announced from Dr. Holub, and the thanks of the Society voted to the donor.

Mr. Newton (a visitor) again exhibited, by request, under the microscope, some examples of multiple staining of vegetable tissue with aniline dyes. The sections being placed successively in a mixture of the dyes—the various stellatures taking different colours—thus bringing them into prominence and forming many beautiful objects for the microscope.

Mr. C. Lloyd Morgan read his paper on the "Alleged Suicide of Scorpions."

In the discussion which ensued, the following gentlemen took part, viz.:—Mr. Freeman, Rev G. H. R. Fisk, Mr. Silberbauer, Sir J. H. le Villiers, Dr. Gill and Mr. Gamble.

Mr. Trimen read a "Note on *Tinea vastella*, a South African Moth whose Larva feeds on horn," and exhibited a ram's-horn received by Mr. F. Guthrie from the Graaff-Reinet district, to which were attached numerous cases fabricated by the larvæ of the moth in question.

He gave a *resumé* of what was known of the species, and called attention to the fact that one observer, many years ago, had purchased antelope horns at the River Gambia, with the blood of the newly-killed animals on them, which were full of what appeared to be the larvæ and larva-cases of this or of some closely-allied insect. This solitary observation had never been confirmed, and it would be interesting to ascertain whether the larvæ of *Tinea vastella* really did inhabit the horns of living animals.

The tough silken cases, intermingled with earth, attached to Mr. Guthrie's ram's-horn, had evidently penetrated the ground at the points on which the horn rested, and this had given rise to the statement of his correspondent that horns, left lying in the veldt, "took root" there. This was a great variation in habit on the larva's part from its usual way of burrowing in the substance of the horn.

The Rev. G. H. R. Fisk and Mr. Guthrie took part in the discussion which ensued.

The Secretary read Dr. Elkin's paper on the "Longitude of Kimberley."

Dr. Gill remarked on the inaccuracy of the determinations of longitude up-country, and on the desirability of securing better ones.

Dr. Elkin stated that the authorities at Kimberley were not using the longitude laid down on the map but were using one much nearer the truth.

Special Meeting.

MONDAY, March 5, 1883.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Prof. Green, M.A., F.G.S., gave some notes "on the Geological Observations he had made during a recent journey in South Africa, with special reference to the scientific points to which colonial geologists would do well to turn their attention."

Prof. Green's remarks were listened to with great attention, and the thanks of the meeting were moved by the Hon. J. X. Merriman and voted unanimously.

Ordinary Monthly Meeting.

WEDNESDAY, April 25, 1883.

Mr. C. LLOYD MORGAN IN THE CHAIR.

Donations of books were announced from Dr. Holub, and the thanks of the Society voted to the donor.

The Secretary read Dr. Elkin's paper on "The Astronomical Photometer," and Capt. Balfour's paper on "Some South African Rivers."

Mr. Dunn made some very interesting remarks on the rivers mentioned in Capt. Balfour's paper, agreeing with his recommendations for utilising the Oliphant's River.

The discussion was continued by Dr. Kitching, Mr. Bolus and Mr. C. Lloyd Morgan.

The thanks of the meeting were voted to Dr. Elkin and Capt. Balfour for their interesting papers.

Mr. Dunn exhibited two specimens of a tree *Capparis Oleoides*, which looked as if the bark had been enclosed by successive layers.

Ordinary Monthly Meeting.

WEDNESDAY, May 30, 1883.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

A donation of books was announced from Dr. Holub, and the thanks of the Society voted to the donor.

Mr. H. W. Oakley read a note on the *Peripatus Capensis*, and exhibited a number of specimens which had been born in a state of captivity.

Mr. C. Lloyd Morgan gave some particulars of an interesting specimen he had secured six months ago, and stated that he had once found specimens near the top of the Devil's Peak.

Mr. Gamble then proceeded to read a paper by Mr. A. B. Brand, C.E., on the Beaufort Dam.

Dr. Gill remarked on the value of the paper and on the striking application of the lesson taught to some existing circumstances in the Colony.

Mr. Kirkwood considered the Beaufort Dam a very great success, and recommended Cape Town to proceed on the same lines as had been finally adopted at Beaufort.

Mr. Auret (a visitor) said he understood that Van Wyk's Vlei Dam, carried out on the President's plan, was the cheapest first-class work in the world; and that for £20,000 a dam had been constructed to hold six times as much water as the portion of Loch Katrine available for Glasgow.

The Rev. G. H. R. Fisk and Mr. Alston also took part in the discussion; and Mr. Gamble replied to the various questions asked.

The thanks of the Society were unanimously voted to Messrs. Oakley and Brand for their interesting papers.

Ordinary Monthly Meeting.

WEDNESDAY, June 27, 1883.

Mr. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

Mr. T. Stewart, of Cape Town, was duly elected an Ordinary Member of the Society.

A donation of books was announced from Dr. Holub, and the thanks of the Society voted to the donor.

Dr Beck read a paper on "The Origin of the Camp-fever at Kimberley."

Dr. Atherstone remarked that he was at Kimberley in 1871, and that he noticed the fever germs were carried about to a greater extent in moist weather.

Mr. Hutchins stated that he had lived for many years in a malarious district in India: he agreed on the whole with Dr. Beck's remarks. He considered, however, that extreme heat was not a determining cause.

Dr. Beck in reply said that very possibly fermentative change went on in the moist weather at the Fields, and referred to a paper in the *Lancet* on the development of malaria in moderately dry sand.

Mr. E. J. Dunn then read a paper "on the Transvaal Gold Fields," and exhibited a large number of specimens of auriferous quartz.

The thanks of the meeting were unanimously voted to Dr. Beck and Mr. Dunn for their valuable and interesting papers.

Annual General Meeting.

WEDNESDAY, July 25, 1883.

MR. J. G. GAMBLE, M.A., PRESIDENT, IN THE CHAIR.

The Secretary's and Treasurer's Reports were read. Both reports were unanimously adopted.

The Members then proceeded to the election of President and Council for the ensuing year. Messrs. Trimen and Fisk were elected scrutineers for the ballot.

The President then proceeded to deliver his address, which appears in the present volume. At the close of the address the result of the ballot was declared as follows :—

President,—Roland Trimen, F.R.S., F.L.S., F.Z.S.

Members of Council,—H. Bolus, F.L.S., W. H. Finlay, B.A., F.R.A.S., Assoc. S.T.E.E., the Rev. G. H. R. Fisk, C.M.Z.S., J. G. Gamble, M.A., M.I.C.E., F.R.M.S., D. Gill, LL.D., F.R.S., F.R.A.S., F. Guthrie, LL.B., P. C. MacOwan, B.A., Hon. J. X. Merriman, M.L.A., J. Sivewright, M.A., C.M.G., Hon. C. A. Smith, M.A.

A vote of thanks to the President for his excellent address was moved by the Hon. C. A. Smith and carried unanimously.

REPORT ON THE PROCEEDINGS

OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY

DURING THE YEAR ENDING JULY 30, 1883.

1. Since the last Annual General Meeting one Special and nine Ordinary Monthly Meetings have been held. The average attendance of Members at the Meetings has been 12 and that of Visitors about 8, making the total average attendance of Members and Visitors about 20.

2. At the Monthly Meetings 17 papers have been read before the Society. Of these 4 related to Astronomy, 3 to Geology, 3 to Natural History, 1 to Medicine and 6 to Miscellaneous Subjects.

3. Donations have been received from Dr. Holub, the Sydney Museum, the office of the Geological Survey of Canada, the Department of Mines, New South Wales, and La Societa Africana d'Italia.

4. During the Year 14 Ordinary Members have been elected. The Society has lost 2 Members by death and 1 has resigned on leaving the Colony. The total number of Ordinary Members is 78.

5. Volume II., Part III., of the Society's Transactions has been issued to Members.

6. The thanks of the Society are due to the University Council for granting the free use of its rooms for the Society's Meetings.

7. The Council is of opinion that the Society may fairly be congratulated on the progress made during the last year. More papers are forthcoming and more interest is felt in the Society than at any previous time.

By Order of the Council,

W. H. FINLAY,

General Secretary.

THE TREASURER IN ACCOUNT WITH THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

FOR THE YEAR ENDING 30TH JUNE, 1883.

Dr. 1882.							Cr. 1883.						
July 1.			£	*s.*	*d.*	£ *s.* *d.*				£	*s.*	*d.*	
To Balance	Fixed Deposit		200	0	0		By Advertising and Stationery			32	6	6	
	In Standard Bank	£63 3 5					By Hire of Room and Expenses connected with Lectures			13	7	3	
	Less cheque outstanding	2 0 0					By Printing Transactions	£61 9 2					
							By Correcting Proof	3 0 0					
			61	3	5				64	9	2		
	Petty Cash		1	5	11		By Clerical Assistance			36	0	0	
						262 9 4	By Fees to Collector of Subscriptions			8	2	0	
To Subscriptions	Current		142	0	0		By Landing Charges			3	1	9	
	Arrear		22	0	0		By Petty Expenses			2	17	8	
						164 0 0	*June* 30.						
To Interest on Fixed Deposit at 6 per cent						12 0 0	By Balance	Fixed Deposit	200 0 0				
To Overpayment on Subscriptions						0 3 0		Bank Balance £84 5 4					
								Less cheque outstanding	7 17 0				
										76 8 4			
								Petty Cash		1 19 8			
											278	8	0
						£438 12 4					£438	12	4

CAPE TOWN, 24*th July*, 1883.

C. ABERCROMBIE SMITH, *Hon. Treasurer.*

We, the undersigned members of the South African Philosophical Society, do hereby certify that we have examined the above account, compared the cash payments with the vouchers, and the balance with the Bank Pass Book and Fixed Deposit Receipt, and find the same to be correct.

CAPE TOWN, 24*th July*, 1883.

C. R. EATON,
FRED. F. RUTHERFOORD, } *Auditors.*

ANNUAL ADDRESS DELIVERED TO THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY,

ON WEDNESDAY, JULY 25, 1883,

By JOHN G. GAMBLE, M.A., M. INST. C.E., PRESIDENT.

CONTENTS :

1. *Addresses of previous Presidents, Sir Bartle Frere, Mr. David Gill; prophetic warning by the latter.*
2. *Work of the Society during the last two years, Astronomy, Meteorology, Geology, Natural History, Medecine, Philology and Antiquities, Applied Science.*
3. *Exhibits; lectures, Father Perry, Professor Green.*
4. *Botanical catalogue, MacOwan and Bolus.*
5. *Drawings of plants, H. Bolus.*
6. *Ill-success of public lectures.*
7. *Research.*
8. *Scientific work independent of the Society, Transit of Venus, Comet, Longitudes, Meteorological Commission, Forestry, Animal Pathology, Bee culture.*
9. *Death of G. Stow, the Geologist.*
10. *Accuracy.*
11. *Thoroughness.*
12. *Future of South Africa.*
13. *Commemoration of Benefactors, Dr. Holub, Sir Bartle Frere.*

LADIES AND GENTLEMEN,—The rules of South African Philosophical Society provide that the office of President cannot be held by the same person for more than two years consecutively. Hence, the previous occupants of this chair, to wit, our honoured founder and benefactor, Sir Bartle Frere, and Her Majesty's Astronomer at the Cape, Mr. David Gill, have adopted the principle of giving a discourse on a special subject at the end of their first year of office, and at the end of the second year a more general address on the work of the Society and the advancement of South Africa. Thus Sir Bartle Frere began by giving us a study of the native races of South Africa, and on the second occasion indicated a suggestive programme of the various fields for the work of the Society. Mr. Gill gave us first a masterly discussion of the methods adopted for determining the earth's distance from the sun, a subject peculiarly his own. At the end of Mr. Gill's second year we heard from

him a general discourse on the work done by the Society as well as on some points, chiefly educational and sanitary, which we in South Africa should more carefully lay to heart. I would call the attention of fathers and schoolmasters to the arguments, by no means too strong, for *workshop instruction*. On this subject I will venture to quote some words of the eminent James Nasmyth, as given in the very interesting autobiography recently published :—

"The eyes and the fingers—*the bare fingers*—are the two principal inlets to sound practical instruction. They are the chief sources of trustworthy knowledge in all the materials and operations which the engineer has to deal with. No *book* knowledge can avail for that purpose. The nature and properties of the materials must come in through the finger ends."*

And I need scarcely call to your minds the words, burning like those of a Hebrew prophet, which we heard two years ago in the Library from Mr. Gill on the subject of the unhealthy state of Cape Town. The following remarks were strangely prophetic :—

"Every neglected sewer makes Cape Town more liable to danger. . . Where small-pox has come before, it can and will come again. . . Some neglected quarantine precaution ; some tainted garment, and the germ of the disease is introduced—introduced into a hot-bed ready prepared, with an awful suitability for its propagation."

Twelve months had scarcely passed after these words were spoken, and small-pox was in our midst.

Last year I had the honour to bring before you the modern views on the relation between the pressure of the atmosphere, as measured by the barometer, and the horizontal movement of air as perceived in the wind.

It would be easier for me, and possibly more interesting to you, were I now to choose some subject on which I may have had special opportunity of study, and on which I might perhaps more fairly claim your attention. But I am inclined to think it will be more helpful to this Society if I follow in the steps of my predecessors, and speak of the work of the Society, and of some points connected therewith. As Juvenal says :—

"Quidquid agunt homines . . .
. . . . . nostri farrago libelli."

The Society has now been in existence six years, and though our work has not been insignificant, yet we are by no means entitled to a year of rest. It has often occurred to me that those who cry out loudest for a day of rest often forget the condition previous to rest, namely, that for six days you should labour.

The following papers have been read during the past two years.

In *Astronomy* Mr. Gill and Mr. Finlay have described their observations of Finlay's comet, and Mr. Finlay illustrated by means of a

*Life of Jas. Nasmyth, p. 97.

model the orbit of that comet as deduced from their observations. Dr. Elkin read a short paper on the longitude of Kimberley, and another on an Astronomical Photometer.

In *Meteorology* Mr. David Gill exhibited a diagram showing the remarkable changes in the direction of the wind on the 27th March, 1882, as registered by a new gauge recently fixed on the roof of the Royal Observatory. This gauge is arranged to record continuously on a paper cylinder moved by clockwork both the velocity and the direction of the wind. This diagram showed that in the short space of twenty-four hours several cyclonic disturbances must have passed over this part of South Africa. Mr. Gill also read a paper on the different results obtained by the various methods of exposing thermometers in observing air-temperature. This is a subject urgently demanding enquiry, for in the words of the veteran Sir George Airy, "the mere observation of getting the temperature of the air is one of the most difficult things I know." Mr. W. B. Tripp sent us a very interesting paper on the river Buffalo, with especial reference to its discharge, as measured near King William's Town, and the connection between that discharge and the rainfall in that neighbourhood. His remarks were especially valuable as showing the need of putting a stop to the destruction of the forests near the head waters of that and other rivers. I had the honour to bring before you some diagrams showing the strangely different results obtained from rain-gauges in very slightly different circumstances. I also read a paper on Summer and Winter Temperature in South Africa.

In *Geology* Mr. E. J. Dunn gave us some notes on colonial coals, a subject of the utmost practical importance. Mr. Dunn also, last month, gave us a paper on the geology of the Transvaal Gold Fields. It is much to be regretted that, owing to the fact that another valuable and interesting paper was read on the same evening, Mr. Dunn was obliged to condense his remarks, and, moreover, there was no time to elicit the views of several persons in the room also competent to speak on the question. The diagrams carefully drawn by Mr. Dunn and the many valuable specimens brought by him from the Transvaal were a source of great interest.

In *Natural History* we have had a paper from Professor MacOwan on the "Recently Discovered Phalloid Fungi of South Africa." From Mr. Trimen we heard of the "Tinea Vastella." Mr. Lloyd Morgan read some most interesting notes on "Animal Intelligence," and also described some experiments on scorpions. Dr. Bradshaw sent us some notes on birds of the Orange River. Mr. Oakley, the assistant secretary, has deserved well of the Society. He has contributed a paper on the Osteology of the Secretary-bird, two papers on the Snakes of South Africa, a paper on the Peripatus Capensis, as well as notes on the Cotton-bird, and some observations on a discolouration of the bird called "White-eye," caused by the pollen of an aloe.

In *Medicine* we have recently heard an eminently practical paper by Dr. Beck, on the Camp Fever of Kimberley. I am glad to say that Dr. Beck also promised further communications, and I hope that his brother

practitioners will follow so excellent an example. We are all very much in the dark about the many peculiar diseases that affect both men and other animals in these parts of the world.

In *Philology and Antiquities* we have had an interesting controversy between Dr. Theophilus Hahn and Mr. Hyde Clarke on the alleged similarity between the Kafir languages and those of Australia. Dr. Hahn also gave us a paper on the progress of South African Exploration. We were all much struck with the fact that some of the geographical features of inner Africa, notably the great lakes and the bend in the Congo, were known three hundred years ago, but became forgotten or discredited until recently re-discovered by explorers like Speke and Livingstone, Stanley and Cameron.

In *Applied Science* I have explained my proposals for utilizing the very considerable rainfall on Table Mountain in supplying our suburban villages with pure water. I have shown that a great portion of this rainfall passes away either on the surface or through springs into the ocean at Hout's Bay. I also exhibited and endeavoured to explain the working of a sun-engine. Machines of this kind have had a fair amount of success in France and Algeria, and if they could be produced cheaply they will no doubt succeed well in South Africa; where ordinary fuel is so scarce and where sunshine is so abundant. I note that the manufacturers have taken out a patent here. I had also the honour of describing a new method of rowing, which has recently been successfully adopted in a boat made for the purpose on the Thames. In this method the rowlock, or what corresponds to it, is placed on the opposite side of the boat to the blade of the oar. That is, if the oar is dipping into the water on the starboard side of the boat the rowlock is on the port side. this enables the oarsman to face the bows of the boat, and gives him the great advantage of seeing where he is going. It is real rowing and not backing water, the oar being pulled in to the body. I endeavoured to point out the advantages and disadvantages of this system. I am certainly inclined to think that for a pleasure tour on a comparatively small river like the Upper Thames it is decidedly preferable to the old way.

Captain Balfour gave us a paper on South African Rivers, more especially dealing with the Olifant's River, Clanwilliam. Mr. Brand sent a paper on the Beaufort West dam, which, being the record of a failure, and of the retrieving of that failure was of great practical interest.

Besides actual papers we have had most interesting *exhibits* from Mr. Trimen, Mr. Oakley, Dr. Shaw, Mr. E. J. Dunn, the Rev. G. Fisk, and others. It would take up too much time to enumerate them; but I would point out that exhibits may often be as interesting and lead to as valuable discussion as actual papers. I need scarcely remind those who exhibit specimens of natural objects that it is most important to give accurately the date and place of discovery.

We have also heard a valuable lecture from Father Perry, S.J., on eclipses of the sun, illustrated by some very beautiful photographic lantern slides of the strange phenomena connected with the outer surface of the sun.

Professor Green, the eminent geologist, who came out at the invitation

of the Colonial Government to report on our coal-fields, was good enough to give us an account of some of his observations of South African geology, with the inferences he drew from them. As you will remember, he began with the sandstone range of the Zwartberg to the south of the Karoo, and gave us a description of all the overlying strata, touching in a suggestive manner on the formation of coal and of diamonds, and indicating the probable sequences of elevation and denudation.

Perhaps the most useful work yet done by the Society has been the publication of the catalogue of printed books and papers relating to the botany of South Africa, a catalogue compiled by Professor MacOwan and Mr. H. Bolus.

Another work worthy of the Society will be the engraving of some drawings of our plants made on scientific principles by Mr. H. Bolus. The Council have decided to engrave a portion, and trust that their funds will suffice for the publication of more.

The experiment of public lectures given by members of the Society was not satisfactory: the money collected at the door did not pay, as was hoped, for the hire of the room. It was an experiment strongly urged by many competent judges, though not by myself. Even supposing that popular lectures were a good medium of scientific instruction, yet it is not the function of this Society, at any rate directly, to supplement the defective scientific education of ourselves and our neighbours. When a great specialist like the Rev. Father Perry, or like Professor Green, visits our shores, we may ask him to give us words of instruction, of warning, or of encouragement, but our aim, or, as the logicians would say, our "final cause," is Research. I would remind you that research is one of the most valuable methods of education. It is an accepted law of modern educationalists that the child must be led to find out knowledge for itself rather than have knowledge pumped into it, for the struggle after a truth hitherto unperceived is more likely to bring out the capabilities of our nature than any amount of assimilation of other people's ideas.

And here I would venture to differ from my eloquent predecessor in this chair. Mr. Gill told us that the percentage of men naturally fitted for research is small. We out here certainly cannot be expected to make many great original advances in science. The rewards offered here are not likely to tempt a Sylvester or a George Darwin, a Siemens or a Francis Balfour. Even those amongst us whose training and antecedents might lead us to hope for original work have other life-tasks. Still it is not the "prima donna" alone that makes the opera successful; the man-of-war requires the able seamen as well as the admiral. I rather say, the number that might help is very great and would be greater if scientific methods were more carefully taught in schools. In the old countries of Europe it is perhaps disheartening to the young enquirer to find that everything seems to have been done already, and that at any rate he must spend years in studying the results achieved by others before he can begin to do original work for himself. But in a new country like South Africa there is a wide field for research; in many branches very little has been done, and to be useful only requires some

scientific training and much steady perseverance. Everyone who makes microscopic sections of rock, who studies the fertilization of a flower, who watches the transformation of an insect, who traces the path of the cirrus cloud, or counts the rainband lines in the spectrum, is helping to push forward the outposts of knowledge.

I could enumerate many more directions in which the willing brain could do good work in this new country. Sir Charles Lyell* quotes with approval the following saying ;—

"Local information from actual observation tends more to promote natural history and science than all that is done by the speculations and compilations of voluminous authors."

Moreover minds coming fresh to the work may succeed where those fail who are biassed by the pet dogmas of a school, the *idola theatri* of Bacon. As Sir John Herschel says :—

"The most barren and unpromising fields of enquiry may be converted as if by inspiration into rich and inexhaustible springs of knowledge and power on a simple change of our point of view by bringing to bear some principle which it never occurred before to try."

Independently of the Society, valuable work has been done. We have to congratulate two of our members, Mr. David Gill and Mr. Roland Trimen, on winning the highest distinction in the English scientific world—the Fellowship of the Royal Society :—

Vos "doctarum hederæ præmia frontium,
Dis miscent superis."

The transit of Venus was observed by several well-equipped parties in South Africa. Mr. Finlay has the honour of being the first discoverer of the remarkable comet that some months ago "brandished its crystal tresses in the sky." Dr. Elkin and Mr. Finlay had the delight of making the absolutely unique observation of a comet coming up to the face of the sun and disappearing at it. The calculation of the orbit from the observed positions showed that the comet really passed between us and the sun. The other day we saw Venus on the face of the sun with our naked eyes. When Mercury is crossing the face of the sun, he can be seen with a small theodolite telescope, but Mr. Finlay and Dr. Elkin, with the powerful telescopes at their command, could see nothing of the comet, thus showing that the solid nucleus, if any, must be extremely small. This comet was remarkable as having had actually the longest tail of any comet of recent times. I say "actually" because others have had apparently longer tails, but then the earth was more favourably situated for their observation. I cannot leave the subject of comet's tails without reminding you what an extraordinary phenomenon they are. We no longer believe that—

"A comet . . . . .
. . . . . from his hair
Shakes pestilence and war."†

* Life, vol. i, p. 44. † Milton, Paradise Lost, ii. 710.

But the scientific explanation of the formation of a comet's tail is no less strange. We are accustomed to think of attraction as determining everything. The general movement of the sun and moon and planets, as well as of most bodies on the earth's surface, obeys this law, and though we have exceptions in molecular physics and in electricity, yet these phenomena are not on sufficiently large a scale to attract attention from others than specialists. But the only reasonable explanation of comet's tails is that they are the effect of *repulsive* forces: repulsive forces on a truly gigantic scale.

Mr. David Gill and the Observatory staff have been worthily occupied in determining *longitudes* by the electric telegraph. I need scarcely point out the importance of this. We are told that Kimberley is considerably misplaced on the map of South Africa, and that the Free State and Transvaal towns are worse. But it is to the sailor that accurate longitudes are all important. Practically a sailor depends on his chronometer for his longitude. The errors of a chronometer not only vary as the time since the last verification, but they vary in an increasing ratio. Some time ago 1,700 chronometers were tested at the Liverpool Observatory and the results tabulated. The average error from the whole observations, expressed in geographical miles on the Equator, was :—

For a chronometer that had not been checked for a month, 6 miles.
For a chronometer that had not been checked for 6 months, 56 miles.
For a chronometer that had not been checked for 12 months, 136 miles.

Thus we see the importance of accurately fixing the longitude of lighthouses, headlands, and other points that ships sight during a long voyage.

In another Society doing, I believe, good work—the Agricultural Society—it was stated that there were no records of rainfall in the colony. I would refer the gentleman who made that statement to the reports of the Meteorological Commission. The Government have for some time past established rain-gauges at all gaols; and besides there are a large number of private observers. One hundred and sixty-six rain-gauges spread over the country were observed in 1882. Any willing observer able to guarantee a continuous register is supplied with a gauge. The Secretary of the Commission makes a journey once a year and inspects the position of the gauges and tests the capability of the observer. Thus the results are, as a rule, trustworthy and good.

The Meteorological Commission have not been idle in other branches of their subject. By means of annual inspection the records from distant stations have been better than of old. Some self registering instruments have been imported and are now being tested at the Royal Observatory. It is to be hoped that by means of them we may obtain some trustworthy records of the hourly variation of temperature and pressure for other places in the colony besides the Royal Observatory. We shall then be able to get a fairly approximate value of mean temperature and pressure; that is to say, having got the mean from 8 a.m. or any other time con-

venient to the observer, we shall be able to correct that mean so as to tell us the mean for the day, or the mean for any other hour in the day.

The subject of weather telegrams is under discussion, and I trust the Commission will not slacken their endeavours until at any rate a system of storm-warnings, similar to that adopted in Europe and North America, is in force for the benefit of our Eastern ports.

The Comte De Vasselot de Regné, the Superintendent of Forests, has been doing excellent work in introducing a scientific system into our neglected forests. On the northern border I have seen thorn trees on Crown land ruthlessly cut down merely that the young shoots may be food for goats. The fine "kameeldoorn" is becoming extinct in those parts owing to the demand for fuel at Kimberley. No re-planting is attempted. In the Amatolas the natives destroy hundreds of young saplings to build a hut/ In the long droughts the huts are frequently burnt, and are replaced with the same reckless destruction of young forest. I trust the Government will give the Comte both the power and the means to stop these depredations. We know he has the will.

I believe I am correct in saying that the researches of the Colonial Veterinary Surgeon, Mr. Hutcheon, are likely to be of great benefit. I hope he will not be content to leave his results to the neglected pages of Blue-books, but afford us, at one of our monthly meetings, the opportunity of understanding and discussing his experiments.

Several of our members, notably Mr. Trimen and the Rev. G. Fisk, have been diligent in contributions to English Societies, and His Honour the Chief Justice has sent to the pages of *Nature* some most interesting observations on bees.

South Africa has sustained a great loss in the death of George Stow, of Bloemfontein, the geologist. Though not one of us, he was with us, and was an original observer of great merit and industry. It is to be hoped that the large mass of materials collected by him may not be entirely lost.

I have urged the prosecution of scientific research, and in connection with scientific work there is a quality as to which I should be glad to say a few words—accuracy. I allude especially to accuracy of measurement or calculation. Accuracy is a relative term; we seldom attain such a thing as absolute accuracy. Twelve marbles sold at a penny each, the cost is one shilling. This is an example of absolute accuracy, but if the marbles are sold by the pound, the pound might mean something between three-quarters of a pound and a pound and a quarter; or it might mean something between fifteen and seventeen ounces, or the weight might be more accurate still, though still only relative. In the preface to Raper's Navigation, some useful advice is given on this subject:—

"Very indistinct and erroneous notions prevail among practical persons on the subject of accuracy of computation; and much time is, in consequence, often lost in computing to a degree of precision wholly inconsistent with that of the elements themselves. The mere habit of working invariably to a useless precision, while it can never advance the computer's knowledge of the subject, has the unfavourable tendency of deceiving those who are not aware of the true nature of such questions

into the persuasion that the result is always as correct as the computer chooses to make it; and thus leads him to place the same confidence in all observations, provided only they are *worked* to the same degree of accuracy."

And Merrifield in his "Technical Arithmetic" has the following :—

"It is bad in principle to use more figures than are actually needed in any kind of work, for every additional figure, besides giving needless labour, introduces an additional chance of making a blunder. Students not unfrequently work with 10 or 15 decimals, where the second decimal place is scarcely reliable, simply because they do not know how to get rid of the useless figures. This is not good work. The utmost that should be done is to keep a sufficient margin not to add an error of arithmetic to an uncertainty of measurement."

I would ask mathematical teachers, some of whom are very ready to complain of supposed inaccuracies in the examination papers, if they would teach their pupils contracted multiplication, and other labour-saving processes—processes by no means only found in the newest text books.

Two important questions should be asked in all practical work, (1) what accuracy is required for the results; (2), what accuracy is given by the observations. Engineers and surveyors would do well to consider these points. Take the case of an estimate of a large earthwork excavation, say a hundred thousand cubic yards. I have seen estimates given to the nearest pound, sometimes shillings and pence being added. But a yard of earthwork, though occasionally priced to farthings, is seldom priced nearer than the nearest penny. That is, if we think it will cost more than eighteen pence we price it nineteen pence or twenty pence, and so on, so that our price, and consequently our result, proceeds by steps of about 5 per cent. at a time; hence the pretended accuracy is absurd. The surveyor also, who is obliged to compute the sides of a Karroo farm to the nearest hundredth of a rood, that is to an inch and a half, is wasting his time. But a frontage in Adderley-street would require this or greater accuracy. Of course if by measuring the sides and angles of a farm with extreme accuracy we could join the diagram of one farm to that of the next, and so make a map of the colony, there might be some use in it, but every one who knows what trigonometrical surveying means understands that this is impossible. And surveyors in practice do not take their measurements to this accuracy. The various corrections required for measuring a base line, the expansions and contractions of the measuring instrument, the heights of the stations above sea, &c., are not found to this accuracy; even the station flags are scarcely plumbed to this accuracy.

With regard to accuracy in practical work I would venture to give two rules :—

1. To preserve a thorough scepticism as to your own and everyone else's accuracy. I do not mean to say that in all cases action must be delayed till accuracy is obtained. Life is too short for that. But the

observer or practical man must never rest content as long as further verification is practicable.

2. In all problems, especially in those where you do not know beforehand the approximate result, get a rough result if possible by an entirely different method—I would strongly urge the use of graphical methods. Areas calculated by co-ordinates should be checked by the planimeter, roof and bridge calculations should be checked by strain-diagrams, &c. Graphical calculation is especially useful because it enables the accuracy of the premises to be immediately compared with the accuracy of the result. And very large errors or slips are extremely improbable.

The mention of accuracy leads me to add a few words on the allied quality—"thoroughness." Our work, but especially our school and University education, is too superficial. There was some merit after all in that old grammar school training where Latin and Greek composition were studied mainly, if not exclusively, for ten years of a lifetime. Instruction is not education; it is better to master some one thing thoroughly and be able to apply it, than to have learnt by heart an encyclopœdia and be unable to do one thing well.

The system by which a student, ambitious of high honours, is forced to cram a lot of subjects which he cares nothing about, and which he begins to forget the day after the examination, is not a system to be encouraged. There are signs that this system is dying out elsewhere. And here I would say a word to the advocates for teaching physical science in schools. Far be it from me to decry physical science either as mental training or as a useful preparation for practical life; but experimental science must be taught experimentally. If the study of physical science only means the getting up of text books; Lyell's geology being crammed by boys who have never used a hammer; Roscoe's chemistry by those who have never soiled their fingers in a laboratory; then in the name of true education give us back the old classics, even accompanied by the absurd grammars of Eton and Westminster.

With regard to the future of South Africa there is no need to be despondent. It is true that we are passing through a period of financial depression, but if we only lay the lessons it teaches to heart we may be sure that not merely *alles is nog niet verloren*, but that *alles zal regt komen*. Periods of material prosperity are often times of intellectual stagnation; it is one of the sweet uses of adversity that it braces our nerves and teaches us to put our shoulder to the wheel. Democritus told us man is only a half slave of necessity.

The Kimberley miners in their haste to get diamonds have neglected ordinary principles of mechanics and have allowed the cliffs of that wonderful pit to fall and overwhelm them; and yet the Inspector of the mine tells us in his recent report that there is little or no doubt that the best days of Kimberley mine are yet to come. Farmers have gone too hastily into the breeding of ostriches, and have neglected what after all is, and I believe will always be, the standby of South Africa—the merino sheep and the Angora goat. Still in Oudtshoorn and most other parts of the colony we find more land under cultivation this year than ever was cultivated before. Every time one makes a journey

through the back country one finds more cultivation and better-made dams. The farmers seem at last to be doubting their old fond belief that if a dam bursts it is a visitation of the Almighty.

The want of labour is often put forward as an excuse for the large proportion of land on many farms which is lying uncultivated; but how is it that in the four great farming States of the American Union —Illinois, Indiana, Ohio and Iowa—there is only one labourer to every four farmers?

I cannot conclude more fitly than by reminding you of two of our benefactors. In doing so I would feel inclined to imitate the old college chaplain who was not merely content with offering thanksgiving for past benefactors but prayed for new ones.

Nearly every month we acknowledge the receipt of valuable w rks from the indefatigable Holub. These are helping to form a scientific library. We are expecting Dr. Holub out again shortly to pursue his labours of exploration. I would call attention to an excellent sketch of Holub's life, written by the Vice-President of the Geographical Society of Karlsruhe, and published in the *Augsburger Allgemeine Zeitung* last September, a copy of which he has presented to our library. The lesson of Holub's life is of inestimable value to us, teaching us to push on patiently, shrinking from no obstacles.

Celui qui ne perd jamais courage est le maitre de l'avenir.

It is, perhaps, hardly necessary for me to recall to your memory our founder (Sir Bartle Frere). The pain of his loss is too recent, the echoes of his voice still ring in our ears. We may have disagreed with him politically, but in this arena political questions have no place. We are all agreed as to the great loss, socially and intellectually, which we sustained in the departure of himself and his gifted family.

I fear we cannot say, that in founding this Society:

"Exegit monumentum ære perennius,"

but we know that the example of high culture and social refinement will not be entirely in vain, we are sure that the seeds cast upon the waters will bring forth good fruit even after many days.

JOHN G. GAMBLE.

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I. NOTES ON ANIMAL INTELLIGENCE.—By C. Lloyd Morgan, F.G.S., Assoc. R.S.M.

[Abstract of paper read February 22nd, 1882.]

The author took for his text a saying of Carlyle's: "To Newton and to Newton's Dog Diamond, what a different pair of Universes; while the painting on the optical retina of both was, most likely, the same."

He began by pointing out that to no two human beings is the mental representation of the same object quite the same. In the thought called up by the sight of the simplest object we give far more than we receive; and what we give is a special resultant of inheritance and individual acquisition. No two of us give the same in amount or in quality. It is not too much to say that for no two human beings is the world we live in quite the same. How different, then, must be the world of man from the world of the dog. It is difficult or impossible for us to think ourselves into the mode of thought of the savage. And yet the *ratio of the senses* is the same or much the same for savage and civilized. For both sight and touch are the dominant senses; hearing, smell and taste being subsidiary. But in the dog the ratio is by no means the same, smell and hearing, especially the former, taking a more prominent place. The difficulty in putting ourselves into the mental position of the dog is proportionally more difficult.

The dictum of Prof. Max. Müller, "that according to the strict rules of positive philosophy, we have no right to assert or deny anything with reference to the so called mind of animals," was then considered; and the author contended that a belief in the existence of mind in the lower animals is a legitimate scientific conclusion based on the doctrine of evolution. If the doctrine of evolution be rejected the author failed to see any basis for this belief.

The author then rapidly passed in review the lower psychological strata of the canine mind, incidentally stating that he regarded as mental all those processes which are effected by the nervous arc, (afferent nerve, ganglion, efferent nerve), whether such processes were accompanied by consciousness or not. It was pointed out that the

reflex actions effected by means of the spinal cord, and those more important and intricate reflex actions effected by the medulla oblongata (heart-pulses, variable supply of blood to different bodily organs, respiration, swallowing, &c.)—that all these seem to go on in much the same way in dog and man.

Instincts were then considered. The difficulty of drawing any hard and fast line between instincts and reflexes was adverted to, the complexity of the action constituting the main difference. The want of definition of the word "instinct" was commented on, the word being used in a broader and a narrower sense. "In the broader sense instinctive action is automatic action, action performed without any consciousness of choice. In the narrower sense instinct is habit, which through inheritance comes natural to a species."

Some instances of instincts were then given, and attention was drawn to the fact that the connate mechanism was much less developed in the pup than in the pig or the hippopotamus, an instance of the escape of a newly-born hippopotamus from Hottentots who had shot the mother the moment she had given birth to it, being cited from Shunberg, the South African traveller. The fact that many instincts do not make their appearance for some time after birth was then pointed out and attributed to the fact that the neural mechanism required time or complete development.

The difference between habits consciously acquired and habits unconsciously acquired was alluded to, and instances were given of instincts having the one origin or the other. But the author maintained that, with the aid of intelligence or without that aid, all instincts have been formed under the guidance of natural selection and under the more general influence of the uniformity of Nature. (To prevent misapprehension the author noticed that the *conception* or the uniformity of Nature is one of very late development and is obviously impossible for the brute under any circumstances, but the *influence* of the uniformity of Nature is dominant in every mental as it is in every physical process, mind being throughout its development moulded in conformity with an orderly sequence of events.) But in the dog, owing to the canine race having been so long under domestication, instincts originally acquired under the guidance of natural selection may be more or less completely replaced by instincts formed under the guidance of artificial selection (pointing, retrieving, shepherding, &c.).

This modifiability of instinct by artificial selection was dwelt on as a fact of the highest importance, implying nothing less than the alteration of the whole character. What was before pleasurable becomes distasteful; pleasure is associated with an altogether new mode of action. For pleasure and pain are the normal incentives to action. And the whole complex process of evolution has been accompanied by the association of pleasure with such actions as tended to the preservation of the individual and the race, and the association of pain with such actions as were harmful to the individual or the race. It is only in this way that evolution could be furthered by individual action. Without this association of pleasure with right action and of pain with wrong

ɔtion the natural selection of conscious creatures would be impossible. There is a natural selection of *structures* and a natural selection of *ctions*. The two must proceed in harmony and they must be studied ide by side. Every structure is or has been *of use*. It has been deve-oped for the furtherance of right action. But right action if it is to ɔe persisted in by a conscious creature must be associated directly or ndirectly with pleasurable feelings. Nay more, if it is to be persistently persevered in, its non-performance must be associated with that dull form of pain which we call dissatisfaction. Only under these conditions can that form of conduct which leads to the survival of the individual and the race be evolved. The principle of greatest happiness has its roots firmly embedded in the evolution of conduct throughout the whole realm of conscious existence.

The author then summed up the first part of the paper and said "that, first, there are a number of unconscious reflex actions connected with the maintenance of bare life, which can only be called mental in the most extended sense of that word: that, secondly, there are processes hardly if at all to be separated from reflex action, which are performed, perhaps unconsciously, immediately after birth, such as the processes connected with the instinctive act of taking the breast: that, thirdly, there are processes which have not to be specially learnt but come natural at a certain age, such as the act of swimming and the instincts connected with the maintenance of the species, these being evolved under the guidance of natural selection: that, fourthly, there are the instinctive habits of pointing, retrieving and so forth, which also come natural to certain breeds of dogs, and which have been evolved under the guidance of human selection, whereby a radical change of dog-character has been produced."

The author then brought forward a number of instances of animal intelligence which had come under his own observation or that of friends on the accuracy of whose observation he could rely. He regarded the *modification of action to suit special circumstances* as the test of intelligent action.

The question how far such an animal as the dog has the power of forming abstract ideas was then taken up, and the following statement of Mr. Romanes was commented upon. "Give a cat or a dog some kind of meat or cake which the animal has never before met with, and the careful examination which the morsel undergoes before it is consigned to the mouth proves that the animal has properly abstract ideas of sweet, bitter, hot, nauseous, or, in general, good for eating and bad for eating, *i.e.* abstract ideas of quality as apart from the object examined—the motive of the examination chiefly being to ascertain which general idea of quality is appropriate to the particular object examined." The author drew attention to the difference between a generalized conception of things good for eating (which he believed were within the range of canine intelligence) and an abstract idea of "good for eating." The formation of an abstract idea involved, he maintained, the power of *divorcing in thought qualities inseparable in experience*; for example, "good for eating" from a tangible something good to be eaten. This

isolation of qualities he regarded as an outcome of the use of language—a process accompanying the conversion of adjectives, such as sweet, bitter, &c., into abstract nouns such as sweetness, bitterness, &c. He therefore believed that the formation of abstract ideas—that is, *ideas of completely isolated qualities*—was altogether beyond the power of the dog or any other of the lower animals. At the same time he believed that the lower races of human beings were also unable to form truly abstract ideas, though they, like the higher animals beneath man, were perfectly competent to form general conceptions.

The author stated that, after some consideration, he was unable to find *any one faculty which all men possess and which no brute possesses*. At the same time he regarded the gap between the highest brute intellect and the lowest (sane) human intellect as *enormous*, the vast difference being due to the fact that the brute has to be contented with the experience he physiologically inherits or individually acquires, while man, through language spoken and written, profits by the experience of his fellows.

Finally, after speaking of the emotional part of canine character, the author drew attention to what he considered as the exaggerated language that was sometimes used in speaking and writing on the subject of animal intelligence. He instanced the alleged "sense of justice" and "conscience" or the current phrase "the dog knows when he has done wrong." He contended that the look of "conscious guilt" often seen in a dog's demeanour is due, not to the fact that he knows he *has* done wrong, but to the fact that he thinks it excedingly probable that he *will* "catch it." It is the expectation of a reproof or something more, that gives rise to the look of "conscious guilt." In the same way the look of "conscious rectitude" we often see in some dogs is due to the anticipation of a word of commendation. And in general the association in an animal's mind is between the performance of a given act and the occurrence of certain circumstances. When the association becomes definite it probably draws after it a dislike of such actions as have been accompanied by evil consequences and a delight in those actions which have been accompanied by pleasant consequences. And eventually this dislike or delight is transferred from his own actions to the similar actions of others. Hence the cat punishes its kitten that steals. Hence the baboon punishes another for an act that may result in evil consequences. Similarly the so called "sense of justice" (as in the case of a dog which the author had seen in Rio de Janeiro, and which on a merely verbal reproof for an act of theft that he had not committed, absented himself for several days and returned in a pitiable condition), this sense of justice arises from the mental confusion due to a breach of association—certain consequences (a reproof, &c.) not having been preceded by any such act as was usually associated with them. At the same time the author expressed his belief that the love of a faithful dog for his master is such that to disobey him in itself gives rise to a sense of dissatisfaction which may be said to foreshadow the pinch of conscience, and that to please him in itself gives rise to a sense of pleasure which may be said to foreshadow the approval of conscience.

PROPOSALS OF THE TABLE MOUNTAIN WATER SUPPLY COMPANY.—By JOHN G. GAMBLE, M.A., M.Inst.C.E.

[Abstract of paper read April 26th, 1882.]

At least three-fourths of the drainage of Table Mountain runs away the southward and falls into Hout's Bay. Up to the time of the urveys made under the author's superintendence in the year 1881 it as believed that a good supply of water could be got at the "Plateau," wo thousand four hundred feet above sea level, twelve hundred feet elow the top. No doubt in some seasons there is a good supply; and robably some years ago, when there was a good deal more bush on the nountain, the supply was more constant than it is at present. In 1881 he stream on the plateau dwindled down to almost nothing, less than 5,000 gallons per diem, and in 1882 it actually stopped. Of course by rusting mainly to storage, a supply could be got at this height, for an normous quantity of water runs there in winter time. The author has two rain-gauges on Table Mountain, one 2,500 feet above sea level, the other 3,100 feet above sea level. The rainfall on the mountain, more especially at the upper of the two stations, is relatively great, being even larger than the fall at Bishopscourt, which has hitherto proved the wettest place where a gauge is kept. Storage, however, in an artificial reservoir would be expensive and perhaps troublesome, hence it is desirable to utilize as far as possible the natural storage afforded by the pores and fissures of the sandstone. Seven hundred feet below the plateau the stream is stronger, as there are many small springs along the intervening gorge. The stream, as may be seen on the map, bends towards the Atlantic side and comes so close that it affords an opportunity of bringing the water through to the westward by means of a tunnel of reasonable length. This was one of the two schemes suggested by the author to the Town Council of Cape Town, though not the one recommended. But even near the proposed tunnel mouth, the daily discharge in summer fell as low as 65,000 gallons. Below this level, however, there is a very great increase in the permanent flow of springs. All along the south side of the mountain, in the interior of the horseshoe-like valley discharging into Hout's Bay, are springs about one thousand feet above sea level, apparently where the sandstone overlies the granite. The proposal of the company is to collect as many as possible of these springs into one main which will be laid over the "col" or "nek" between Hout's Bay and Constantia and along the Eastern slopes of Table Mountain to the spur joining Wynberg Hill to Table Mountain. There a relief and dividing tank will be built, the Wynberg supply will branch off, while the Rondebosch and Mowbray supply will be carried through Kirstenbosch and Fernwood and along the Newlands avenue. In order to supplement the springs in summer time a reservoir will be constructed in the Disa valley and the water carried down the slope to the before mentioned relief tank. A very necessary accessory to this scheme will be

the planting of trees in all suitable places on Table Mountain, and the protection of the copses that still remain around the springs in the Hout Bay valley.

III. ON THE ANATOMY AND HABITS OF SOUTH AFRICAN SNAKES.—By HERBERT W. OAKLEY.

[Read May 31st, 1882.]

One of the reasons that induced me to prepare a paper on the Anatomy and Habits of some of the Poisonous and Non-poisonous Snakes of South Africa, and how to distinguish a venomous from a non-venomous snake, was caused by occasional remarks I have from time to time overheard of the remarkable dread in which nearly all snakes are held; of extraordinary powers attributed to them in attacking man; in protecting their offspring; and in their partiality for food of which Nature never intended them to partake. Every one is familiar with the story, which it is quite popular to believe, of the Puff-Adder striking backwards; some people even believing that it can spring backwards upwards of eight feet. The Cobra I have been assured has been seen to spring forwards twenty feet. And the black Mamba of Natal is said to put its tail in its mouth and roll after one like a hoop. The Adder is reported to defend its young by allowing them to run in and out of its mouth. And, on the other hand, the young of Puff-Adders are said to kill their parents on being born; and in ancient times they were placed in a bag with a human parricide and drowned as the punishment of this great crime. The Schaap-sticker we are assured kills sheep. But the commonest of all stories is that snakes are so fond of milk that they suck cows, and the native women; and are brought irresistibly out of their haunts or holes if a saucer of milk is placed near the entrance.

To show with what superstition and ignorance snakes have been and are now somewhat regarded in various parts of the world, I may point out that Tylor in his work on Primitive Culture says in speaking of animal worship that Serpent-worship unfortunately fell years ago into the hands of speculative writers, who mixed it up with occult philosophies, Druidical mysteries, and that portentous nonsense called "the Arkite Symbolism," till now sober students hear the very name of ophiolatry with a shiver. Yet it is in itself a rational and instructive subject of inquiry, especially notable for its width of range in mythology and religion. We may set out among the lower races, with such accounts as those of the Red Indian's reverence to the rattlesnake, as grandfather and king of snakes, as a divine protector able to give fair winds or to cause tempests; or of the worship of great snakes among the tribes of Peru before they received the religion of the Incas, as to whom an old author says: They adore the demon when he presents himself to them in the figure of some beast or serpent, and talks with them. Thenceforth such examples of direct ophiolatry may be traced on into

classic and barbaric Europe; the great serpent which defended the citadel of Athens and enjoyed its monthly honey-cakes; the Roman genius Loci appearing in the form of a snake; the old Prussian serpent-worship and offering of food to the household snakes; the golden viper adored by the Lombards, till Barbatus got it in his hands and the goldsmiths made it into paten and chalice. To this day, Europe has not forgotten in nursery tales the snake that comes with its golden crown and drinks milk out of the child's porringer; the house-snake, tame and kindly but seldom seen, that cares for the cows and the children and gives omens of a death in the family; the pair of household snakes which have a mystic connexion of life and death with the husband and housewife themselves. Serpent-worship, apparently of the directest sort, was prominent in the indigenous religions of Southern Asia. It now even appears to have maintained no mean place in early Indian Buddhism, for the sculptures of the Sanchi tope show scenes of adoration of the five-headed snake-deity in his temple, performed by a race of serpent-worshippers, figuratively represented with snakes growing from their shoulders, and whose raja himself was a five-headed snake arching hood-wise over his head. Here, moreover, the totem-theory comes into contact with ophiolatry. The Sanskrit name of the snake "naga" becomes also the accepted designation of its adorers, and thus mythological interpretation has to reduce to reasonable sense legends of serpent-races who turn out to be simply serpent-worshippers, tribes who have from the divine reptiles at once their generic name of Nâgas, and with it their imagined ancestral descent from serpents. In different ways, these Nâga tribes of South Asia are on the one hand analogues of the snake Indians of America, and on the other of the Ophiogenes or serpent-race of the Troad, kindred of the vipers whose bite they could cure by touch, and descendants of an ancient hero transformed into a snake.

Serpents hold a prominent place in the religions of the world, as the incarnations, shrines, or symbols of high deities. Such were the rattlesnake worshipped in the Natchez temple of the Sun, and the snake belonging in name and figure to the Aztec deity Quetzalcoatl; the snake as worshipped still by the slave coast negro, not for itself but for its indwelling deity; the snake kept and fed with milk in the temple of the old Slavonic god Potrimpos; the serpent-symbol of the healing deity Asklepios, who abode in or manifested himself through the huge tame snakes kept in his temples; and lastly, the Phœnician serpent with its tail in its mouth, symbol of the world and of the Heaven-God Taaut, in its original meaning probably a mythic world-snake like the Scandinavian Midgard-worm, but in the changed fancy of later ages adapted into an emblem of eternity. It scarcely seems proved that savage races, in all their mystic contemplations of the serpent, ever developed out of their own minds the idea, to us so familiar, of adopting it as a personification of evil. In ancient times, we may ascribe this character perhaps to the monster whose well-known form is to be seen on the mummy-cases, the Apophis serpent of the Egyptian Hades, and it unequivocally belongs to the wicked serpent of the Zarathustrians,

Aji Dahaka, a figure which bears so remarkable a relation to that of the Semitic serpent of Eden, which may possibly stand in historical connexion with it. A wondrous blending of the ancient rites of ophiolatry with mystic conceptions of gnosticism appears in the cultus which tradition (in truth or slander) declares the semi-Christian sect of Ophites to have rendered to their tame snake, enticing it out of its chest to coil round the sacramental bread, and worshipping it as representing the great King from Heaven who in the beginning gave to the man and woman the knowledge of the mysteries.

In the nineteenth century, when the anatomy and habits of snakes are tolerably well known to science, surely it is high time to give up fallacies which existed in days when myths originated, unfortunately leaving impressions on the minds of many generations, thanks to tradition, a peculiar symbolical architecture, and ignorance of Natural History, and I trust that in the course of this paper I may be able to show you that many of the popular stories and beliefs, some of which I have briefly related, are utterly erroneous and quite at variance with common sense. Also that I may make clear to you why many snakes supposed to be noxious are harmless, how really few species of venomous snakes exist in South Africa, and how that even these are not nearly to be so dreaded as they appear to be at present. In order, however, to make myself understood I must call your attention to a little of the anatomy of serpents, especially to the skull and teeth.

In a paper of this kind I can but glance slightly at the skull of snakes, and will therefore briefly remark that the cranium is made up of a number of bones having their homologues in the skull of mammals. Those which enter into the structure of the maxillary and mandibular arches are of importance in distinguishing the venomous from the non-venomous snakes, and I will therefore give a short description of them.

The bones composing the upper jaw and palate, as also the mandibles, are very movable, those of the mandibles hanging loosely from the tympanic bones, and which are united in front by ligament. The mastoid bones are also movable and are articulated with the tympanic, giving great distensibility to the mouth, which can not only be opened vertically but transversely, and each lateral half has independent and separate motion necessary for swallowing large objects.

The most important bones, as bearing on the difference between the poisonous and non-poisonous snakes, and which I must call to your notice, are, viz: the maxillary, the palatine, the pterygoid, the ecto-pterygoid, and the mastoid. In a typical venomous snake, such as the puff-adder, the maxillary bone is reduced to a mere wedge, giving support only to the poison fangs. Now there is but one fang in each maxilla actually in use and which is anchylosed firmly, it is covered by a fold or capsule of mucous membrane in which it is ensheathed. In this membrane are several reserve fangs, the puff-adder has five in different stages of growth, and which lie loose until one of them is required by the loss of the actual fang. The succeeding one then becomes anchylosed to the maxillary bone, and communicates with the duct of the poison gland.

I must point out that the fang itself has no power of independent ectibility, the erection taking place mainly through the medium of ie articulation of the maxillary bone with the ecto-pterygoid, which is ongated in proportion to the reduction of the former, that its hinge-ke motion enables the snake to depress or erect the fang at will. In a armless snake the maxillary bone is, in comparison to a venomous one, uch elongated and carries numerous recurved teeth more or less firmly xed ; in the majority of non-venomous snakes these teeth are nearly all f equal length, but there is a tendency for one or two of the last teeth o become somewhat longer. In the Boom-slang (*Bucephalus Capensis*), he Schaap-sticker (*Psammophylax rombeatus*), and the so called Night-dder (*Leptoderia rufescens*) they are remarkably lengthened and not nly so but grooved, and there are also usually several reserve teeth olded in a sheath of mucous membrane as in poisonous snakes ; these eeth are, however, not connected with any duct of a special poison gland, so that snakes possessing them could not use them as a means of defence or aggression. They must therefore be looked upon as performing another function, such as retaining in their mouth some creature they are actually proceeding to swallow ; and it may not be improbable they instil into the wound they inflict some acrid saliva which may help to render death more quick in its occurrence.

There is no poisonous snake that I am aware of that has the poisonous fang situated anywhere else than in the anterior part of the maxillary bone.

The poison fangs of snakes are of two kinds, one, as in the colubrine poisonous snakes, having a simple open groove along its anterior surface which conveys the poison from the duct of the poison gland to nearly the apex of the tooth ; and the other, as in viperine snakes, having a groove which is closed nearly the whole length of the fang, making it appear to be perforated, and hence venomous snakes are placed in two classes ; the first with grooved teeth, the *Proteroglyphia*, they being the poisonous Colubrine snakes, which in their general configuration resemble harmless snakes, and the second with canaliculated teeth, the *Solenoglyphia*, or viperine snakes, and which are easily recognised by their large triangular head, thick body and very short tail, and having the scales on the skin keeled.

An easy way of understanding the structure of a fang having a closed poison-canal is to imagine that the crown of a simple tooth has been somewhat flattened, and that its edges have been bent forwards and cemented together, thereby forming a conical shaped hollow open at both ends. The beginning of the flattening and its inflection around the canal begins close above the base, and the joining of the inflected margins proceeds along the anterior and convex side of the recurved fang ; the hollow therefore for conveying the poison is in front of the pulp-cavity. The aperture of the canal is oblique, and its outlet nearly at the apex of the fang is a mere furrow.

As Prof. Owen points out, and which I have proved from practical observation to be correct, the duct which conveys the poison, although it runs through the centre of a great part of the tooth, is really on the

outside of the tooth, the canal in which it is lodged and protected being formed by a longitudinal inflection of the dentinal walls of the pulp-cavity. This inflection commences a little beyond the base of the tooth, where its nature is readily appreciated, as the poison-duct there rests in a slight groove or longitudinal indentation on the convex side of the fang; as it proceeds it sinks deeper into the substance of the tooth, and the sides of the groove meet and seem to coalesce, so that the trace of the inflected fold ceases to be perceptible to the naked eye, and the fang appears to be perforated by the duct of the poison gland.

It follows from the position of the poison-canal that the transverse section of the tooth varies in form in different parts of the tooth: at the base it is oblong, with a large pulp-cavity of a corresponding form, with an entering notch at the anterior surface, farther on the transverse section presents the form of a horseshoe, and the pulp-cavity that of a crescent, the horns of which extend into the sides of the deep cavity of the poison-canal; a little beyond this part the section of the tooth itself is crescentic, with the horns obtuse and in contact, so as to circumscribe the poison-canal; and along the whole of the middle four-sixths of the tooth, the section shows the dentition of the fang enclosing the poison-canal, and having its own centre a pulp-canal in the form of a crescentic fissure, situated close to the concave border of the inflected surface of the tooth. The pulp-cavity disappears, and the poison-canal again resumes the form of a groove near the apex of the fang, and terminates on the anterior surface in an elongated fissure.

Having briefly pointed out the structure of the skull and teeth and the difference between poisonous and non-poisonous snakes, I must now turn to the habits of these reptiles and endeavour to show how many of the stories about them which are in circulation are quite fallacious.

With regard to the parent adder swallowing its young in order to protect them from danger, the best evidence I think I can bring to bear against such an unlikely proceeding is, that there is no special adaptation in the internal anatomy of this snake for such an event to take place, that no instance has ever yet occurred, where young vipers have been born in captivity, of their escaping in case of danger down their mothers' throats, and there is no authentic instance of any one having seen such an occurrence take place where these reptiles have been in a wild state. If the viper had a special cavity for protecting its offspring, as is the case in the pouches of the kangaroo and other marsupials, and if they would obligingly avail themselves of such a protection by going in and out of their mothers' mouths as the young kangaroos do that are born in the Zoological Gardens, where they may be seen hopping in and out of their mothers' pouches, we might believe in the story that has been handed down from generation to generation. But until some peculiar adaptation in the anatomy of the adder has been found for the special protection of its young, and until it has been actually demonstrated that they do go in and out of their mothers' mouths, I think we may do well to disbelieve it. Instances are common of one snake swallowing another, the Hamadryad snake of India especially; but they do it not to protect their weaker brothers but to make a meal of them.

Referring again to the popular idea of the puff-adder striking backwards, there is nothing in its anatomy that would render such an occurrence likely but quite the reverse. No one that I have consulted who is conversant with the habits of this snake has ever seen such an event take place, neither is there any recorded authentic instance of it. For my own part I have seen and captured numerous puff-adders and have kept them alive in captivity, and although I have tried every possible means, while they were yet at large and in captivity, to make them strike backwards, they have refused to do so, always either striking forwards or sideways; and I therefore have come to the conclusion that they prefer to stick to the dictates of Nature rather than to try any acrobatic performance.

No doubt all here this evening are familiar with the story that snakes, more especially the cobra and ringhals, are able to eject poison from their mouths to a considerable distance. Now no one could until recently have been less disinclined to place any belief in the snake's power to do so than myself; but lately I have had the opportunity of actually seeing a gummy liquid like office gum exuding directly from the anterior opening of the poison-canal of the fangs of a puff adder, when it was much irritated. It occurred under these circumstances: I caught a puff-adder alive and held it in my hand round the throat, when it erected its fangs and again lowered them as in the action of biting. I saw liquid exude from the fangs immediately from the opening of the poison-canal and from no other part, which fell into the lower jaw.

On Wednesday last I caught a ringhals. It occurred thus: as I was proceeding with my gun along the Flats at Rondebosch accompanied by my brother, I saw a snake with expanded hood glide almost between my legs and disappear in a hole two or three yards in advance of me. I watched by the hole while my brother went for a spade, and when he returned we set to work digging the reptile out. I had taken but two turns with the spade when I saw the ringhals, and had just time to hold him down with the spade about two or three inches from the point of his tail, when his head and body appeared on the other side of the spade, or rather between the back of the spade and myself; he immediately reared himself up, spread his hood widely and struck at me, ejecting with great precision and with a smothered hiss some liquid which glistened in the bright sunshine like crystal. I saw the fluid coming and threw my head backward, but some of it reached my chin and some fell on my coat. This fluid must have been ejected at last three feet. Soon after he spied my brother and greeted him with the same compliment, the fluid falling on his hand. Having at last with some difficulty captured the ringhals alive, we took him home and placed him in a box with a glass top, where he again struck towards us repeatedly and each time ejected on the glass a clear fluid. I have no doubt whatever that the liquid ejected was mainly saliva, but I see no reason whatever to suppose that a poisonous snake of the nature of a cobra or ringhals when greatly irritated cannot eject with its saliva some of the poison that exudes from the poison-canal, and falls, as I have before stated in speaking of the puff-adder, into the lower lip.

I can but affirm positively that a liquid does exude from the poison-

canal of the fang of a snake when it erects them and when the fang does not actually come in contact with any object, and I state emphatically that the ringhals at least can eject some fluid, whether saliva alone or saliva mixed with poison, to a distance of three feet if not more. The question is, can the liquid ejected do any harm.

Dr. J. Fayrer in his work on the venomous snakes of India, speaking of the poison of snakes, writes :—" But there is no doubt, I believe, that notwithstanding all that has been said to the contrary, it is capable of absorption through the numerous membranes with which it is brought into contact, though with less dangerous effects than when it is introduced into the blood. In certain experiments in which the poison of the cobra was placed on the conjuctiva of dogs, the symptoms of poisoning were rapidly and strongly, though not in all cases fatally, developed. . . The poison may be diluted with water, or even ammonia or alcohol, without destroying its deadly properties. It may be kept for months or years, dried between slips of glass, and still retain its virulence. It is capable of absorption through delicate membranes, and therefore it cannot safely be applied to any mucous surfaces, though no doubt its virulence is much diminished in the endosmosis. It kills when introduced into the stomach, when put into the eye, or when applied to the peritoneum."

Perhaps Mr. Fisk can give an instance of a snake causing inflammation to the eye by ejecting something from its mouth.

The power poisonous snakes have of exuding poison from the fang without actual contact with an object, and of ejecting saliva beyond the lips, was known to Sir Andrew Smith, an authority on South African snakes, but he appears to doubt that it can be ejected anything like three feet. This is what he says. In speaking of the Ringhals (*Sepedon hæmachates*) he remarks, viz :—The aborigines, as well as the colonists, reckon this to be the most courageous of all the South African snakes, and they highly dread the power of its poison. When in confinement, and irritated, it evinces great ferocity, it opens its mouth so as to be in readiness to seize on any object that may approach within its reach, and while open the poisonous fluid is to be seen distilling in drops from the fangs, which are on such occasions always raised to the proper position for performing their functions. During such periods of excitement it often ejects, by some means, a portion of the fluid to a distance from its mouth ; and the inhabitants even affirm that it is able to cast it more than several feet, and that in doing so it generally attempts to lodge it in the eyes of men or animals. Elsewhere he says : I shall take occasion to remark more at length upon this reputed power, which he does in speaking of the South African cobra (Naia haje). This he says " is known throughout the Cape Colony by the name of *Spuugh-slang*, and is so called from the power it is supposed to possess of ejecting its poison to a distance. All the cobras of South Africa distil poison from the points of their fangs when they are much irritated, and are able to eject a portion of it beyond the mouth by a forcible expiration, but that any greater power than that is possessed by this snake I am not disposed to believe ; nevertheless the contrary is strongly maintained both by the European and native inhabitants. Both

of these affirm that the snake in question is able to cast its poison to a distance of several feet, especially if the wind be blowing so as to favour its object; and that it often projects it into the eyes of unwelcome intruders, and thereby occasions a degree of inflammation which not uncommonly terminates in loss of sight.

The oil of tobacco has a remarkable effect on snakes. If a little is placed in the mouth of a snake, in a few minutes it becomes perfectly rigid, as if the muscular tissue was drawn up in lumps somewhat resembling a crooked and knotted stick; but if rubbed it gradually relaxes, and appears none the worse for the dose. This may explain the story of the Indian snake charmer being able to turn a snake into a stick; this feat is performed by spitting into the snake's mouth, then placing the hand on its head until the reptile becomes stiffened; the effect produced is in all probability caused by opium or some other narcotic being introduced with the saliva. They then rub the snake between their hands, restoring it again to its usual animation. Of snakes having a partiality for milk I cannot say that I at all believe the truth of it. I do not mean to say that a snake in its wild state may not drink milk if it can possibly gain access to it, from a pan or other vessel; or that in captivity it may not be brought to drink it freely. A sea-gull will occasionally eat grain in a cornfield when times are hard, and even bread and milk when in captivity, and I have seen an oyster-catcher, a bird that in its wild state lives on molluscs and small fish, eat grain in company with fowls, and take bread and milk from a bowl. But that a snake can suck a cow I am perfectly sure is not only most improbable but utterly impossible. Most quadrupeds have nearly as great a dread of snakes as man himself; and it is utterly unworthy a moment's consideration to suppose that a cow (as I have heard it stated and by those who ought to know better) would allow a snake to climb its leg and quietly go on grazing while the snake was taking its fill. The arrangement of the teeth, lips and tongue of a snake render it practicably impossible that it could perform the feat of milking cows or any other mammal. We may as well believe in fairy rings, the "sea-serpent," spirit rapping or any other nonsense.

The poisonous snakes of South Africa number only twelve species, they are as follows, viz :—

A. Colubrine venomous snakes, with grooved fangs in front.

Fam: Elapidæ.

Naja haje, L. (The Cobra)
Cyrtophis scutatus, Sm. (Hab. Kafirland and Natal.)
Elaps hygiæ, Merr. (Houseband of Cape Colonists.)
Dendraspis angusticeps, Sm. (The Mamba) 10ft. 5in. to 11ft.
Atractaspis irregularis, * Rein.

Fam: Hydridæ.

Pelamis bicolor, Daud. (Black-backed pelamis.)
Hab. Cape Seas.

* The fangs of this snake are so long and the mouth so small as to render it very doubtful whether they could be used except to retain anything that was being swallowed from escaping. It inhabits the Eastern districts of Cape Colony.

I have brought an example of this snake caught at Kalk Bay to show you, for although it is unlike the poisonous snakes we are most familiar with, and has a comparatively small fang, yet it is a very poisonous snake according to Dr. Fayrer. Sea snakes sometimes get on board ship, having been pulled up with lines or nets; and there are several instances on record of men having been bitten and death being the result.

B. Viperine snakes, with perforated or canaliculated poison fangs in front

Fam: Viperidæ.

Clotho arietans, Gray. (The Puff-Adder.)
„ atropos, Linn. (The Berg-Adder.)
„ inornata, Sm. (The Plain Berg-Adder.)
„ cornuta, Sm. (The Horned Adder.)
Sepedon hæmachates, Merr. (The Ringhals.)
Causus rhombeatus, Wag. (The Causus.)

In conclusion I may state that no South African snakes, so far as my observation goes, during four years over a large portion of the Colony and Basutoland, are able to spring off the ground, neither can I find any recorded authentic instance of any South African snake having been seen to do so. Also that snakes unless much provoked, except perhaps on exceedingly rare occasions, will never attack man, but on the contrary will make good their escape as fast as they possibly can.

IV. ELEMENTS OF THE GREAT COMET 1882 (*b*).—By W. H. Finlay, B.A., F.R.A.S, and W. L. Elkin Ph.D.

[Abstract of Paper read October 25th, 1882.]

τ = Sept. 17′ 2242 Greenwich mean time
ω = 69° 32′ 8″
Ω = 345° 59′ 35″ } Referred to the mean equinox
ι = 141° 58′ 59″ } 1882.0
log q = 7 888881

These elements are founded on two meridian observations on Sept. 17, 22, and extra-meridian ones on Sept. 28. The observations are corrected for aberration and parallax from approximate elements previously derived. They represent the middle place almost exactly, and give for the distance of the comet from the centre of the sun at the moment when we saw it disappear at the limb on the afternoon of Sept. 17

963″.2

which is only 5″. 5 in excess of the tabular value of the sun's semi-diameter.

Attention was called to the great similarity of the above elements to those of the comets of 1843 and 1880, but the authors were of opinion that these comets were not returns of the same comet but that they all were undoubtedly members of one family.

THE RIVER BUFFALO, ITS WATERSHED AND FLOW IN CONNECTION WITH THE RAINFALL.—By WILLIAM B. TRIPP, Assoc. M. Inst.C.E.

[Communicated by the President. Read November 29th, 1882.]

In the early part of 1880 the writer having been appointed Resident Engineer of new waterworks at King William's Town, commenced observations on the River Buffalo and its sources, from which that important town draws its water-supply, to the results of which as well as to those of the rainfall he now begs to call attention.

1. This paper was accompanied by three descriptive drawings, viz. :—

   1, 2 & 3. Diagrams showing the actual flow of the river, both at Izeli and the town dam at King William's Town ; the extreme heights of the floods are not in many cases attempted to be represented. The rainfall each day at the Botanical Gardens, King William's Town, is also shown.

   4. A plan of the watershed of the Buffalo—adapted from the Map of the Eastern Border Districts of the Cape Colony, compiled in the office of the Surveyor-General, Cape Town, from various surveys—showing the surrounding contiguous watersheds.

   5. A longitudinal section or profile of the River along its windings from the highest springs on the slopes of Isidingi to the sea at East London.

2. Definite observations on such matters would seem to be much required in South Africa ; much capital, for instance, having been expended in erecting water-worked machinery on the stream under consideration, which such observations would show to be of too intermittent a nature to afford sufficient power to work it continuously, and therefore the steam engine or some other motive power would seem to be a preferable or a necessary adjunct to the water wheel or turbine.

Still more important and necessary are such observations for laying out works for irrigation or town water supply.

3. The River Buffalo has its chief sources in the Perie Bush, the fountains issuing from the slopes of the hills at an elevation in some cases of nearly 4,000 feet above the level of the sea.

The effect of a range of mountains in condensing vapours driven on to them and causing rain is well-known. In the case, however, of a barren and denuded range of hills, a very large proportion of the rainfall quickly runs off, and the issuing stream is intermittent and partakes of the character of a mountain torrent.

Now whatever effect the clothing of hills and valleys with foliage and herbage may have on the production of rainfall, and it is no doubt a very important one, still one of the most useful as well as apparent effects of the process appears to be that by its means the whole watershed is converted into a storage reservoir, absorbing and retaining for a long period a large proportion of the rainfall, preventing its too rapid

evaporation, and regulating the discharge to an equable flow spreading health and fertility along its course.

There is also this difference between vegetable growth and mountain ranges, which brings the former subject within reach of practical experiment, that whereas we are perforce compelled to accept the latter as we find them, the former may be increased and the water supply improved and regulated with its growth, and vice versâ.

To what extent the destruction of the Perie Bush has changed the character of the Buffalo from that of a steadily flowing stream to an intermittent torrent, the observations taken by the writer extend over too short a period to enable him to speak with any certainty. That the Forest is gradually disappearing there can be no doubt, and the great probability, judging from experience gained elsewhere, is that such a change is taking place.

4. The total area of the watershed draining into the Buffalo is from 450 to 500 square miles, and it is bounded by the ridges dividing it from the watersheds of the Keiskama and the Kabousie, the Chalumna and the Gonubie, the Igulu and the Nahoon, the Igoda and a few other smaller streams flowing into the sea to the S.W. of East London.

The main points around the watershed are the Perie Mountain, culminating in Isidingi or Mount Kemp, Debe Nek on the West, and the high ground near Kei Road Railway Station on the East, Tamacha Heights and the ridge along which the old road to East London passes on the East, and the corresponding ridge on the West along which the new road passes. The greatest length of the watershed is from 70 to 80 miles, measured in a direct line from East London to Mount Kemp or Debe Nek, which are each about equidistant from it; and its greatest width from 20 to 30 miles from Tamacha Heights to those near Kei Road Station.

The total length of the river along the windings of the principal channel is about 70 miles.

5. The portion of the river more immediately under observation is that from which the water supply of King William's Town has for many years been taken, and this part is chiefly supplied from two streams, viz., the Buffalo proper and the Wytela stream, whose junction takes place about 10 miles above the town, measured along the channel. Other streams such as the Balasi join it between that point and the town dam, but they are not continuous, ceasing to flow in the dry seasons.

The area of watershed above the junction of the above two streams is from 80 to 90 square miles. The portion drained by the Buffalo is larger, has much higher mountains, and a greater area still covered with forest, consequently the discharge from it is much greater than that from the watershed of the Wytela.

Below this junction down to the town dam by which the water is diverted into the furrow supplying King William's Town, the stream passes through farms occupied by German immigrants, and has its channel cut deep below the level of the adjoining lands down to the rock, the banks on each side exhibiting a bed of rich soil resting on a deep loamy deposit.

The successive beds of loam seen in a passage down the valley present appearance of having been the beds of a series of lakes at one time ounded by the successive outcrops of the strata of rocks, whose dip ugh slight is suitable in direction for producing such effect, but by sion the rocks were gradually lowered, and the lakes were at the same e gradually being filled by matter washed down from the hills; by se combined processes all the waters were at length gathered into channel, which was gradually deepened until the channel was conously formed on the underlying rock beds.

Other temporary channels have left marks of their existence, and apar to have acted as feeders or drains eventually rendered unnecessary the deepening and widening of the main drain or channel.

Marks of floods may be distinguished by debris washed up in places me 30 feet above the present bed of the river.

Causes such as those attempted to be described above will account for e frequent steep approaches to "drifts"* walled in on each side by high nks of loam, which form such a characteristic feature in South frican scenery.

6. The rainfall at King William's Town—from the valuable observaions taken at the Grey Hospital since the year 1868 by Dr. Egan—nay be taken at an average of 27 inches yearly, of which the normal listribution throughout the year is as follows:—Rather more than onehird of the whole quantity falls in the summer months, from January o March, and rather less than that quantity during the spring months, October to December. About one-sixth of the whole falls in the autumn, from April to June, and rather less than one-sixth in the winter, from July to September.

The wettest observed year was 1876, when 37 inches fell, and the driest was 1878, when the total fall did not amount to 15 inches.

The heaviest fall on record was in May, 1872, when about 9½ inches fell in three days, of which nearly 8 inches fell during 6 hours only. The last great flood in the river is said to have occurred in 1876, others having previously taken place in 1874. Since 1877 a succession of dry years has ensued.

There is usually a drought in winter, and the rainy season is usually inaugurated by a heavy fall just about the end of September or the beginning of October. Some years are, however, exceptional; for instance, the winter of 1881 was very wet, while during the spring of 1881 and summer of 1882 the rainfall was more than 8 inches below the average.

It is to be regretted that no record extending over any considerable period has been kept of the rainfall in the Perie Mountains. It is certain, however, that rains are more frequent, as they are probably much more copious than at King William's Town. From returns published in the report of the Meteorological Commission for 1881, it appears that the fall during the first three and last three months of the year in the Perie Forest was about one-third more than that at King William's Town during the same periods, while the fall in the month of September was about the same in both places.

* Fords.

7. With so variable a rainfall it may be supposed that the flow of the river is extremely changeable.

The ordinary flow may be taken at from 4½ million gallons per day in dry seasons, to 21½ million gallons per day in wet.

The minimum flow is from about 2 millions to nine hundred thousand gallons per day. When the stream falls to that point, even in dry seasons it is apparently invariably replenished by small "freshets" due to rain high up in the mountains raising the flow for the time up to the rate of 13½ to 18 million gallons, and these occurring at frequent intervals constantly replenish the river and prevent its being altogether dried up in the long droughts.

An immense volume of water rushes down the river in the heaviest "freshets." Even a flood raising the water only 2½ feet at the town dam would carry down at the rate of more than 750 million gallons per day, and a 5-feet flood more than three times that amount. These, however, are only floods of a very minor order, of which some 3 or 4 occur each year. About every few years, some say seven, a period of "heavy freshets" is said to occur, which are sufficiently violent to clear out the sand bar at the mouth of the river, rendering the harbour accessible for the time to large vessels.

Rains from the coast often hardly affect the upper parts of the river, while those in the bush are often only known of in the town from their effects on the river. Storms often follow the summits of the hills and are hardly noticeable in the valleys.

The quantity of water flowing at the abovenamed junction of the two principal branches frequently appears—as may be seen by looking at the diagrams accompanying this paper—particularly in dry seasons, to be greater than that at the town dam 10 miles below.

This may be of course accidental at times owing to the long time—varying from 24 hours to 3 or 4 days—that a freshet in the upper parts takes to travel along the windings and fill all the pools of the river, and make itself felt at the lower parts. But the writer is of opinion that the difference is more than accidental, and that the stream in the upper part is more constant, *i.e.* that it does not rise so high or fall so low at the upper point as at the lower, and this is explained in the following manner:—After heavy rain all the temporary feeders run down in torrents, and this raises the lower part of the river in a rapidly increasing ratio as compared with the upper. When, however, all these feeders cease to flow after a long drought, the loamy banks absorb a large proportion of the flow—the water being frequently seen wetting them at least one foot above the surface of the river, being drawn up by capillary attraction—and then there is a greater waste of water, this being much more felt through the bare formed lands than where the stream has just issued from the forest, consequently the flow decreases until the stream reaches the next permanent feeder.

"Freshets" or "Floods" might be always foretold, were observers always on the spot, sometimes a longer sometimes a shorter period beforehand. When the floods come they appear almost suddenly, workmen having to make haste to escape them, if such are engaged in engineering works in the bed of the river.

This is owing to their being caused by a heavy rainfall at a distance, and as the volume increases by continued fall of rain the back waters overtake those in advance by the greater velocity due to their increased volume. This effect of floods caused by rains at a distance is always more or less observed.

On the Vaal River, I understand, the Engineers engaged on the works of the Kimberley Waterworks can hear of advancing floods as much as a fortnight before their arrival, and consequently take every precaution beforehand.

The same has been observed in large valleys such as that of the Trent at Burton, where floods can be predicted and prepared for by observing the amount of rainfall, and doubtless in many other places.

8. The question of the future of the River Buffalo and streams like it is an important one, particularly for the towns and farms situate on their banks.

One thing appears to be very probable, that by the different destructive agencies of bush fires, Kaffir hut builders, sawyers, as well as cultivators of the soil, the area of watershed covered with "bush" or luxuriant vegetation will year by year become more circumscribed, and the flow of stream will become year by year more variable, and at last, the natural storage ground being destroyed, the rain will run off as soon as it falls, causing the stream bed alternately to present the appearance of a torrent and a dry assemblage of boulders.

When the effect of this begins to be sensibly felt artificial storage reservoirs will be required to equalise the flow, taking the place of the natural one destroyed; the expense of these will be considerable, and their result only partially to restore the character of the stream.

9. In conclusion the writer would venture to urge the importance of regular observations in the flow of streams in connection with the rainfall.

In order to do this effectually rain gauges should be fixed at carefully chosen positions all over the area of the watershed.

There can be little doubt that as the importance of these subjects becomes more widely felt Government will undertake as a duty, more and more, the protection of the natural advantages bestowed on countries with a view of benefitting the inhabitants under their rule, and will take greater pains to study the phenomena of Nature.

VI. NOTE ON THE (ALLEGED) SUICIDE OF THE SCORPION.

—By C. Lloyd Morgan, F.G.S., Assoc. R.S.M.

[Read February 27th, 1883.]

There is a current belief, in this colony and elsewhere, that the scorpion, under certain irritating circumstances, will commit suicide. If, for example, a scorpion be placed within a ring of burning grass he is said to inflict on himself a death wound with his own sting. I have

conversed with many people who are firmly convinced, on the evidence of their own observation, that this suicide actually does take place. But on the cross-examination of the witnesses I have found it exceedingly difficult to learn the exact manner in which the suicide is effected, whether it is resorted to after ineffectual attempts to escape, whether death is immediate, and whether any attempts were made to ascertain if the heat alone were not sufficient to cause death.

This question of scorpion suicide has been discussed in the pages of *Nature* (Vol. IX. pp. 29-47, Vol. XX. pp. 553-577), and Dr. Allen Thomson, on the strength of some observations related to him by an eye-witness, lent the weight of his authority to the view that scorpion-suicide is a fact. Mr. G. J. Romanes, however, commenting upon Dr. Allen Thomson's letter, writes, in his volume on Animal Intelligence (p. 225), as follows :—"Still I think that so remarkable a fact unquestionably demands further corroboration before we should be justified in accepting it unreservedly. For if it is a fact, it stands as a unique case of an instinct detrimental alike to the individual and the species."

A year or two ago—at the time of the publication of Dr. Allen Thomson's letter—I made a few experiments and observations on the two Cape species with which I am acquainted. The names of these species I do not know, and Mr. Trimen informs me that he has had no opportunity of determining them. The larger of these two species—individuals of which I have found to weigh 75 grains—is found under stones and under the large round ant-balls of the Cape Flats. The colour is brown, and the pincers of the large chelate pedipalpi are short and fat. The smaller of the two species I have found for the most part under the bark of decaying tree stumps, but sometimes under stones on the mountainside. The weight of the larger individuals of this smaller species is about 8 grains, the colour is a dark sage green with brown spots ; the pincers of the pedipalpi are longer, in proportion, than in the other species. As the experiments I then made led to negative results, I did not think it advisable to describe them until I should have had further opportunities of adding to their number and varying them.

I have recently resumed these experiments and observations. My object has been to drive the individual under observation to despair, under such conditions as enabled me to watch carefully for any act of self-destruction ; and whenever possible, to examine the scorpion after death for any wound such as might be inflicted by the sting. I will now briefly describe the nature of my experiments.

1. Guided by a letter written to *Nature* by Mr. W. G. Biddie (Vol. XI.) and quoted by Mr. Romanes in his Animal Intelligence, I treated several individuals as follows. I enclosed the scorpion in a glass bottle, or wooden box covered with glass slides, and focused the rays of our summer sun on his back. This I continued in some cases until death ensued. Under this treatment the scorpion gets exceedingly excited, and again and again strikes across and over the heated spot, as if endeavouring to remove the source of irritation. In no case was I able to observe any act of suicide. I will here, however, quote *per contra* what was Mr. Biddie's experience. "This experiment," he says, "was re-

peated some four or five times with like results [that is to say, causing great annoyance to the individual under observation], but on trying it once again, the scorpion turned up its tail and plunged the sting, quick as lightning, into its own back. The infliction of the wound was followed by a sudden escape of fluid, and a friend standing by me called out, 'See, it has stung itself, and it is dead'; and sure enough in less than half a minute life was quite extinct."

2. A second method of experimenting which I adopted was to enclose the scorpion in a glass bottle and very gradually heat the bottle over a candle flame, as this method admits of the most careful watching of the individual undergoing torture. I have killed some twenty or thirty individuals in this way. The creatures very commonly pass the sting over the body as if to remove some irritant. Poison exudes from the point of the sting and coagulates when the heat is great. I have not seen anything like the self-infliction of a wound. I may here mention that whenever I have inflicted a wound on a scorpion by means of a needle or otherwise a colourless liquid has at once exuded from the body. Mr. Biddie mentions "a sudden escape of fluid." I have carefully watched for this as a sign of a self-inflicted wound, but have never seen any sign of such escape of liquid. I should mention, however, that in the case of one individual, which I killed in this way, I found on examining the scorpion after death an *irregular hole* in one of the tergal plates, somewhat to one side of the medial line. The wound did not appear to me to be a fresh one: it did not appear to be such a one as would be inflicted by the creature's own sting: there was no appearance of the recent exusion of any liquid matter.

3. I was somewhat surprised at the results I obtained by the method of experimenting commonly resorted to, namely, surrounding the scorpion with a ring of fire. My first experiment on this method I made in the following way. I took a newspaper, moistened a ring about a foot in diameter with alcohol, and placed the scorpion within the ring. The paper was by this time alight. The scorpion without hesitation walked through the fire and tried to make his escape. I varied the experiment. I made a ring of red hot wood embers and placed the scorpion in the middle. He pushed his way out, displacing two of the embers. I made a better fire-wall and put him in the middle again. He crept over the embers. I then placed him in the midst of a ring of embers on the flat and much heated stones of the fireplace. He crept over the embers again, but this time died before he could escape. I varied the experiment again. I placed a layer of a quarter of an inch of alcohol in a shallow vessel, lit the alcohol, and placed the scorpion in the midst of the burning spirit. Once more: I placed a similar layer of alcohol in the shallow vessel, but formed an island in the middle. I then lit the alcohol and placed the scorpion on the island. In one case the scorpion fell over into the burning spirit; in a second case I found that the scorpion was dead, death having been caused by the heat, for in this case there was no striking by the tail along and across the back as is so usually the case, the creature having directed its sting towards the projecting pieces of stone on his island.

4. Dr. Allen Thomson's friend was in the habit of causing scorpions to commit suicide by suddenly exposing them to a bright light. This was so successful that "it was adopted as the best plan of getting rid of the animals." I have tried this experiment but with no result. On turning over ant balls I have repeatedly exposed a scorpion, hitherto in complete or almost complete darkness, to the full glare of South African sunshine. I have also held scorpions by means of a pair of forceps, grasping one of the pedipalpi, against the globe of a lamp, thus exposing them to a bright glare and a considerable amount of heat. The scorpions sting at the forceps and at the glass, wetting both with their poison.

5. In another experiment I moistened the bottom of a large beaker with a thin layer of sulphuric acid (concentrated), and put in a scorpion. The creature died in a few minutes. I have also tried other strong acids and a concentrated solution of potassium hydrate. In no case could I observe any act of suicide.

6. In another experiment I placed a small pellet of phosphorus on the back of a scorpion, and lit the phosphorus with the touch of a heated wire. The creature tried to remove the phosphorus with its sting, carrying away some of the burning material.

7. I have also tried the effect of electric shocks. The scorpions persistently struck at the wire from the battery, but did not commit suicide.

8. I have drowned scorpions in water, alcohol and ether, and killed them by placing them in a bottle with a piece of cotton wool moistened with benzine. No suicide.

9. My last experiments are I think among the most interesting. I held a scorpion by one of the pedipalpi with a pair of forceps and grasped the sting with a second pair of forceps. I then held the individual near the globe of a lamp until in his anger he had emitted a drop of poison which collected on the end of the sting. Bending the tail backwards over the back I then forcibly inserted the sting, and released the scorpion, keeping him under an inverted tumbler. In no case (I have tried the experiment on 9 individuals) has death ensued in less than 1½ hours. In one case the creature became helpless after a quarter of an hour, recovering again after the lapse of a similar time and dying in about four hours. This individual was the first I experimented on in this way, and I held him in the forceps across the thorax instead of by the pedipalpus. I am convinced that some poison gained admittance to the wound in each case. It is well to notice, however, that very much more would, in all probability, be injected in the case of a voluntary sting.

Members of the society will see on the table a scorpion of the larger species. That scorpion I caught at 11 o'clock this morning. I at once pierced him in three places with his own sting, on which in each case was a drop of the poison. In the last inoculation I held the sting in the wound, and squeezing the bulb of the sting with the pincers forcibly ejected poison. The creature is alive and active.

Such, then, are my experiments and observations on this subject. The conclusion I arrive at is that neither of the two species on which these experiments were made have any suicidal instinct. I am inclined

think that the current belief arises, partly from the fact that the orts of the scorpion to remove the source of irritation (or an imagined urce) are put down by those who are not accustomed to accurate obrvation as efforts at suicide, partly from the tendency to fancy one es that which one expects to see. On one occasion I called in one of y servants to watch the experiment of gradually heating a scorpion in glass vessel. The creature, as is usually the case, began moving its ing across and over its back. Upon which my servant exclaimed: See, it is stinging itself." I do not wish to imply that such cases of lleged scorpion suicide as that recorded by Mr. Biddie are merely intances of careless observation. But I do wish to state clearly that after naking a series of observations as carefully as I could on a large number of individuals, I cannot record a single instance of clear and unmisakeable scorpion suicide.

For the sake of those who are unacquainted with the nature of biological problems it may be well to state clearly my object in the above described investigation.

The view that scorpions possess an instinct of self-destruction which is brought into play when the creatures are hard-pressed, is one that is supported by scientific authority of acknowledged weight. Now if this habit of committing suicide be an established fact, we have in scorpions a highly persistent type of creatures who inherit a habit detrimental alike to the individual and the species. *Scorpion suicide, therefore, if a fact, is one of the strongest individual cases against the theory of Evolution by Natural Selection that is presented to us in the animal kingdom.* It has seemed to me that the only way of settling the question is by the direct appeal to experiment. But is the theory of natural selection of sufficient importance in its bearing upon human life and human progress to justify the infliction of pain upon, say, 60 scorpions? I am one of those who believe that it is. I am one of those who believe that the theory of evolution has enormously influenced human thought and action, and is destined to influence it in a constantly increasing degree. I believe that much of the moral and intellectual progress of our race is indissolubly associated with this theory of evolution. I may be wrong in that opinion, but that is the opinion I hold, and holding that opinion it became to me a duty to do something towards settling a question which seemed to me to be of so great importance in its bearing on the evolution theory. And it has been my object to do the work as far as I could thoroughly and once for all. I believed that if I could show that even under torture scorpions do not commit suicide, the view that they do so when irritated by the bright light of a candle flame became highly improbable. To establish a negative in the face of positive assertions is, however, difficult, and I considered it necessary to experiment upon a number of individuals. There are some, however, who consider such experiments unnecessary because the theory of evolution is now so strongly established that scorpion suicide is *a priori* impossible. But I hold it to be dangerous in the extreme, in the present position of science, to set up the theory of evolution as a doctrine from which to draw deductions *unchecked by an appeal to Nature where such appeal is possible.*

VII. NOTE ON TINEA VASTELLA (ZELLER): A SOUTH-AFRICAN MOTH WHOSE LARVA FEEDS ON HORN.—By ROLAND TRIMEN, F.L.S., etc., Curator of the South-African Museum.

[Read February 27th, 1883.]

Mr. F. Guthrie has handed to me a ram's horn from the Graaff-Reinet district of the Colony, which, at his request, was sent to him as a sample of the manner in which, according to his correspondent, horns left exposed in the veldt "took root" in the ground. It will be seen that the horn in question bears on the convexity of its widest curve near the base a mass of earth everywhere penetrated by root-like bodies attached to the horn; and that the remains of a smaller cluster of earth and root-like bodies exist at the point of the horn. It is evident that the horn, which is much fissured and bears the marks of long exposure, must have rested on the surface of the ground at the parts just mentioned.

The elongate bodies at the first glance certainly bear a very vegetable aspect; but a pupa-skin projecting at the end of one of them unmistakeably pointed to the work of some insect; and I at once thought of the horn-feeding *Tinea vastella* as the possible fabricator of the "roots." Mr. Guthrie having handed over the horn to my keeping, I have since kept a watch on it, and four moths have emerged, of which I exhibit three. They are of the species just named, and their pupa-skins will be noticed at the ends of the pseudo-roots, which are in fact only the tubular galleries in which the larvæ of the moth reside. Many of the *Tineida* larvæ construct portable cases just large enough to contain them comfortably, but some make more or less incomplete silken runs or galleries among the material on which they feed. In the present case the tubular abodes are remarkably strong, compact, and capacious, varying from 1½ to 4 inches in length, and are composed of densely-felted silk externally coated with fine particles of earth. Internally they are smooth and glossy, and their substance and toughness is like that of thick glazed brown paper. The end of each tube is open where attached to the horn, but completely closed at the free extremity.

I took two specimens of this moth at Knysna as long ago as 1859; they flew into a lighted room in the evening. In the following year Mr. Stainton, the distinguished historian of the *Tineina*, founded (Trans. Ent. Soc. Lond., n. s., vol. V., p. 221) on these specimens a new species; and, as the moth is a giant in the group to which it belongs, he named it *Tinea gigantella*. He afterwards discovered that the same species had been described by Prof. Zeller in 1852 as *Scardia vastella*.

Lord Walsingham, while preparing his recent excellent paper on the Micro-Lepidoptera of South Africa (Trans. Ent. Soc. Lond., 1881, p. 219), devoted special attention to tracing what was on record regarding the reputed horn-feeding habits of the larva of *T. vastella*, particularly as it had been stated that the horns of *living* animals were attacked as well as those of dead ones. The result was (1) valuable

evidence from Mr. Stainton, Prof. Zeller, Colonel Coke and others, in support of the identity of this moth with the larva well known to eat horns in this country; and (2) the testimony of Dr. J. Fitzgibbon that certain horns of the Eland and Great Water-buck, exhibited in 1856 at a meeting of the Dublin Zoological Association, were purchased by him at the River Gambia, with the blood of the animals still undried upon them, and at the same time "perforated by grubs enclosed in cases which projected abundantly from the surface of the horns." The larvæ remaining in these cases were examined by Dr. Neligan, and the conclusion he arrived at was that the structure exhibited was "not inconsistent with the probability that it belonged to some of the *Tineidæ*."

Lord Walsingham notes that in this instance no specimens of the perfect insect were obtained; so that it is quite uncertain whether the insect concerned was *Tinea vastella* or some other species. He further remarks that Colonel Coke, who had "shot very large numbers of various species of horned animals in South Africa," and had noticed how exposed horns of dead animals were almost invariably attacked by these larvæ, had never seen the horn of a living animal perforated by one of them, and was confident that if the insect did attack the living animal it could not have escaped his observation.

At the same time, as Lord Walsingham in conclusion observes, so little change is undergone by the fibrous substance of the horn at the death of the animal, that there is nothing impossible in the supposition that the moth might deposit its eggs on a horn while the animal is at rest, and the young larvæ there emerge and perforate the horn. There is, however, no known *Tinea* that has been observed to possess this or similar habits, the numerous species either attacking wool, fur, horsehair, feathers, &c., or decaying wood and fungi. The question is thus one of some interest, and I commend its investigation to those members or their friends who have the opportunity of examining the living or freshly-killed larger ruminants of this country. I incline to the belief that, if this *Tinea* really attacks the living buffalo and larger antelopes, it will also be found not to spare domesticated oxen, etc.; but I have never heard any complaint or mention of the latter being the case.

While in England in 1881, I exhibited at a meeting of the Entomological Society of London, specimens of the larva-cases, pupæ, and perfect insects of this species, which had been sent to me by Colonel Bowker, of D'Urban, Natal. This gentleman wrote that he had forwarded to England a *hoof* of the troop-horse killed with the Prince Imperial in Zululand in 1879, in order that it might be mounted as an inkstand. Since the return of the mounted hoof, he had been obliged to take it to pieces to get rid of a quantity of these moths, which came out of it and were still continuing to emerge up to February, 1881. The larva-cases in this instance were quite short, and with none of the tough consistency of those attached to the ram's horn now exhibited. No doubt the larvæ must have been very young when the hoof was despatched to England, or their presence could hardly have escaped the notice of the workman engaged in converting it into an inkstand.

The larva-cases from the hoof were the first that I had seen of this species; and the very different character of the root-like ones attached to the exterior of the ram's horn indicates a noteworthy power in *T. vastella* of adapting itself to circumstances. It is certainly remarkable that, instead of tunnelling in the substance of the horn, the larvæ have burrowed into the ground, lined their burrows with the densely-felted silken tubes described, and only superficially eaten the horn in pits and grooves.

VIII. TELEGRAPHIC DETERMINATION OF THE LONGITUDE OF KIMBERLEY.—By W. L. Elkin, Ph.D.

[Read February 27th, 1883.]

During a recent visit to Kimberley I was enabled, through the kindness of Mr. George Kilgour, Manager of the London and South African Exploration Company, who procured an excellent 8 inch Theodolite from Mr. Orpen (formerly) Surveyor-General of Griqualand West, and put his Chronometers and Observatory at my disposal, and the courtesy of the General Manager of Telegraphs and his able representative at Kimberley, Mr. McIntyre, who put me in direct communication with the Royal Observatory, Cape Town, to get an approximate value of the longitude of the Diamond Fields.

On the night (January 19, 1883) on which signals were sent from the Observatory, I secured altitudes of 4 stars, 2 east and 2 west, and the range of the resulting chronometer errors was not greater than quarter of a second. Adding to the apparent longitude 0^s.2 for retardation of the current, the longitude of Mr. Kilgour's observing place comes out

$$25^m \quad 9^s.3$$

East of Royal Observatory—or

$$1^h \quad 39^m \quad 5^s.0 \quad (24^\circ\ 46'\ 15'')$$

East of Greenwich, and I do not think the first value can be erroneous to the extent of more than quarter of a second. I may add that the sun was observed forenoon and afternoon on January 17 and 18 and the time of the ordinary 1 p.m. signal from Cape Town noted. These two days gave for the longitude

Jan. 17, 1883	25^m	$9^s.0$
„ 18, „	25^m	$9^s.9$

the mean of which is very near that given by the stars. This latter, however, is much more reliable, on account of the difficulties of effectually protecting the delicate instruments—especially the spirit level—from the distorting effects of a tropical sun, and the advantages of specially sent signals.

X. NOTES OF LECTURE DELIVERED TO THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY ON 5TH MARCH, 1883.

Professor Green commenced his remarks with a description of the rocks of the range to the south of the Karroo, a portion of which is called Witteberg. These he described as consisting of contorted *quartzite*, and he pointed out the desirability of examining their sections with the microscope. He accounted for the hardness of the rock by the deposit of silica in the pores of the sandstone under great pressure, and noted that crystals of quartz were found in these rocks.

Below the quartzite are found shales with fossils of apparently Silurian age.

Above the quartzite is the *Dwyka conglomerate*, which Professor Green does not consider to be a trap but a sedimentary rock. It is very desirable to get thin slices for the microscope and to examine whether the base, which is hardened mud, contains crystals. Profcssor Green did not find any definite signs of ice action, but he saw marks which he considered to be suspiciously like ice scratches. Much remains to be investigated in reference to this conglomerate. Has the quartzite been denuded in the formation of it, or was the quartzite pushed up? Among the boulders of the conglomerate are quartzite lumps very like the Witteberg quartzite.

Above the Dwyka conglomerate comes the lower Karroo beds, or, as they are more appropriately called by Mr. Dunn, the *Ecca beds*. These consist chiefly of alternate layers of claystones and sandstones. Professor Green explained that he distinguished claystone from shale by the fact that the latter is easily split into thin laminæ but not so the former. The sandstones of these Ecca beds weather like basalt. The series is well seen on the Queen's Road between Graham's Town and Fort Beaufort. As yet no fossils have been found in it, the layers are much folded though not so much as the quartzite. Professor Green suspects that the Ecca beds lie unconformably on the conglomerate. The conglomerate may have been thrown down in heaps, or perhaps the wavy surface is due to denudation.

Above the Ecca beds come the *Karroo beds* proper, consisting of sandstones and shales, the clay beds being more shaley in the Karroo rocks than in the Ecca beds. The southern escarpment of the Nieuwveld and Sneeuwberg consists of these Karroo beds; they are easily recognized from the almost perfect horizontality of the strata; they extend across the Orange River to Fauresmith; they are probably of the same age as the Red Marl of Europe. Beyond Fauresmith there are only shales and no sandstones. This is the rock in which the diamond-bearing pipes occur. From Kimberley to Winburg it is always shale. At Winburg there is lower Karroo. In this district are limestones which Professor Green believes would give a valuable hydraulic lime. The Karroo beds do not always lie on the Ecca beds, but in some places shales are interposed.

Above the Karroo are the *Stormberg beds*. These consist chiefly of hard thick layers of sandstone. The transition from the Karroo to the

Stormberg is sudden. The shales of the Stormberg are not highly coloured like those of the Karroo, red shales being the exception. There is a great deal more sandstone than shale. The thick layers of sandstone form bold krantzes. It is in these beds that the colonial coal is found. Professor Green said there are two ways in which coal-beds have been formed, (1) land growth coal and (2) subaqueously formed coal. In (1) the plants and trees which have become coal are in *situ*. Between the layers of coal are beds of clay called "underclay" by the miner. These beds are the soil in which the plants grew and died. Owing to a lowering of the land a layer of vegetation becomes covered with silt; this vegetation is covered up and after centuries of heat and pressure becomes coal. The new trees and plants grow in the layer of silt, and eventually a fresh layer of vegetation is formed which is again covered by a layer of silt. This sort of coal is the best, it is more free from earthy matter, and hence when burnt is freer from ash. In the case of the second kind, rivers have brought down dead trees and plants and formed layers of coal in some lake under water. This coal is irregular in thickness and gives a large percentage of ash. Professor Green is afraid that nearly all the colonial coal was formed under water; there is no trace of the "underclay." If one breaks a piece of colonial coal parallel to the bedding it hardly seems coal at all. If broken across the bedding it shows fine lamina, bright and lustrous. When the stream is low, the water is clear, and coal is formed at the mouth; after heavy rains the stream brings mud down, and a thin film of black mud is deposited on the vegetable matter. These thin films give the ash. There are curious boulders like quartzite resting on the beds of coal.

Above the coal-beds is the *Cave Sandstone*, lying in beds 150 to 300 feet thick and forming white cliffs.

Above the cave sandstone are *red shales*.

The highest rocks are *lavas*, an open air formation bedded and full of vesicles. This rock has been largely swept away by denudation. The highest points in the Stormberg are capped by it.

The lavas extend over all Karroo beds, vary in quality and are not generally full of bubble holes. Where light and spongy they have been pumped up to the surface before cooling. Others have cooled under great pressure.

Professor Green then gave his idea of the formation of these South African rocks. He supposed a high steep escarpment of quartzite to be largely denuded. First the Conglomerate and Ecca beds were formed, and folded and bound together. After that a big lake occupied the interior in which the Karroo and Stormberg beds were deposited. Then a period of volcanic outburst in which the lava dykes were formed. Ever since that time South Africa has been dry land and subject to subaerial denudation.

With regard to the *diamond fields*, Professor Green said the "blue" was a decided *breccia*. Fragments of gneiss, mica schists, loose garnet and green silicate are found in it. It no doubt came from below, though the suggestion has been made that the diamonds were formed out of the adjacent carbonaceous shales. Still Professor Green has no doubt the mines are volcanic throats.

Professor Green gave eloquent testimony to the work of Andrew Bain, main outlines of whose scheme are still unassailable, subsequent logists having but filled up the gaps. The lecturer also spoke of the ue of Mr. E. Dunn's observations, and of the hard work effected by n.

Professor Green's remarks chiefly bore on the points he had noticed in s journey through the Colony. He did not pretend they gave an haustive account of South African Geology.

Professor Green hoped to find time on his voyage to England to write s report to Government on Colonial Coal Fields; at any rate he would nd it in time to be printed before the next Session of Parliament.

THE POLARIZING PHOTOMETER AND ITS APPLICATION TO α CENTAURI.—By W. L. ELKIN, Ph.D.

[Communicated by the Secretary.]

This form of Photometer was devised by Prof. Pickering, of Harvard University: the principle of it had already been made use of by Prof. Wild, of the Russian Meteorological Service. It is used to compare the relative intensities of two bright points (stars) A & B. A Rochon prism forms two images of each star A′ and A″, B′ and B″, which are polarized in perpendicular planes (this fact has been verified by Wild). These images are then viewed through a Nicol prism. If v is the angle from the vanishing point of A′ and B′ we have

$$A' = A \sin^2 v \quad A'' = A \cos^2 v$$
$$B' = B \sin^2 v \quad B'' = B \cos^2 v$$

If we make $A'' = B'$ we have

$$\frac{A}{B} = \tan^2 v$$

from which we can deduce $\frac{A}{B}$ when v is known. The vanishing point is not determined but eliminated. In this way measures have been made by Messrs. Gill, Finlay and myself of the relative intensities of the components of the bright star α Centauri:—

	mag.
Gill	1·10
Finlay	1·13
do.	1·46
do.	1·25
Elkin	1·33
do.	1·11
do.	1·18
do.	1·18
do.	1·16
mean	1·23

The light-ratio of one magnitude to the next is taken at 2·5, so th the above difference corresponds to 3·1 of light-ratio. This result interesting, as from a careful discussion of the motions of these two st it appears certain that their masses are very nearly equal or at least n different by more than one-tenth of their amount. They are therefo undoubtedly of different physical constitution. Another valuable applica tion of this instrument is to photometric measures of the Satellites Jupiter. The Satellite which is being eclipsed is compared with one the others at some distance from the planet. The light of this latte may be assumed constant and affords a reference point by which th progress of the eclipse can be measured.

XI. ON SOME SOUTH AFRICAN RIVERS. —By J. E. Balfour, C.E.

[Communicated by the President. Read April 25th, 1883.]

The writer began by giving some statistics of the *Orange River*. He stated that the fall of the river bed between the point where the Telle Spruit joins it on the South-West border of Basutoland to Prieska averages about three and a half feet per mile. The level of the water is from 30 to 40 feet below the land on each bank. The great flood of 1874 rose at Prieska and in other places between 50 and 60 feet above the bed of the river, flooding the strip of alluvial soil more or less covered with trees which is found along both sides of the river.

With regard to the *Olifant's River*, Clanwilliam, the report of Mr. Philip Fletcher, written in 1862, gives a very complete account, especially from the point of view of navigation. In 1882 Mr. Balfour was instructed by the Hydraulic Engineer for the Colony to visit the river and to take the necessary levels and measurements for the purpose of ascertaining what means could be employed to use the water for irrigation. Mr. Balfour's report on the Olifant's River is printed as an appendix to the Hydraulic Engineer's report for 1882. The total length of the river is a little more than 150 miles from its source to the sea, and it drains an area of 13,000 square miles. Its perennial waters are derived from its tributaries rising in the Cold Bokveldt and the Cedar Bergen ranges. Some of these streams rise high up in the mountains, which are chiefly composed of sandstone, and bring down water comparatively pure and clear of silt; they run constantly, and although the water of some of them is subjected largely to loss from absorption, evaporation, and in some places from irrigation, they nevertheless maintain a strong perennial flow. Comparatively little rain falls in the basin proper of the river itself. The tract of land from the village of Clanwilliam following the river to the sea and westward to the coast being of a very dry character, the rain clouds pass over this track and break upon the Cold Bokveldt and the Cedar Bergen, supplying the streams on the Eastern as well as the Western slopes. The lower tributaries are the Doorn, Troe-Troe and Holle Rivers, which

w only occasionally after heavy thunderstorms, or occasional falls of n. Their physical characteristics are dry and torn up channels with rupt variations in the inclination of their beds, flat when passing rough level plateaus, steep when rushing through abrupt and narrow sses, high banks in alluvial or soft soil, and often bounded by perpencular escarpments in mountainous or hilly tracks. These tributaries ain an enormous extent of country, from the border of Bushmanland the North to Vogel Vlei and Calvinia on the East, and the Roggeveldt ountains on the South. When in flood they rush on precipitately, idening their channels, undermining their alluvial banks, fretting and aming to escape through the rugged and narrow poorts, arriving with mighty rush at their debouchure, where they disgorge their semiuid contents into the river, which, if the flood is great enough to overow its banks, leaves a rich deposit of Karroo silt spread over the nd, enabling the cultivator to produce crops which appear almost abulous.

Ordinary floods of the Olifant's River rise from ten to twelve feet bove its bed; these are the results of the winter rains supplying the pper tributaries. Extraordinary floods are the results of heavy rains ithin the drainage area of the lower tributaries, and very extraordinary floods are most probably produced by an exceptionally heavy rainfall taking place simultaneously over the whole of the drainage area.

The *Berg River* is the third of our western rivers flowing into the Atlantic; it is 130 miles in length and has a drainage area of nearly 4,000 square miles; its tributaries are all supplied by the winter rains falling westward of the Great Winterhoek and Drakenstein mountains. Unfortunately the character of our rivers, and especially the three above mentioned, render them unsuitable for navigation. The Orange, Olifant's and Berg have each a constantly moving sand bar drawn across their mouths upon which the surf breaks dangerously, almost prohibiting entrance. Small vessels drawing eight feet of water have sailed up the Berg with the tide for a distance of thirty miles, but during the greater part of the year the reduced quantity of water flowing towards the sea renders it unsafe for anything but very small craft to ascend.

The Olifant's River has a very safe land-locked harbour if entrance could be obtained to it, but the varying sand banks which stretch across the channel of the river at intervals along its course a short way below the surface of the water are obstacles to the navigation of vessels any larger than boats. The tidal wave ascends the Olifant's River a distance of 25 miles and it ascends the Berg 45 miles.

The supply of water to our rivers is of a fitful kind owing to the nature of the country which they drain and the unstable character of the rainfall. One year may be characterized as particularly wet, and the two or three succeeding years particularly dry, or in the east of the drainage area a drought may prevail and in the west unusual heavy rains may fall simultaneously. It is likewise affected by the permeability or impermeability of the ground.

The normal condition of some rivers and tributaries is perfect dryness,

they only flow after heavy rains. The most characteristic river of this kind in the western district is the Zak, a large tributary of the Orange River flowing through the Nieuwveldt and Achterveldt; its length is little over 350 miles from the Roggeveldt and Nieuwveldt mountains where its course begins; its drainage area is approximately 32,100 square miles and is almost devoid of vegetation, except the stunted bush on which the possessors of farms equal in area to English counties graze a few thousand sheep. When a thunderstorm breaks over this tract or when a general rain prevails, the Zak becomes a river of fluid mud keeping within its banks generally till somewhat north of Brandvlei where it has not yet formed any definite channel and where it loses much of its water among the long flat stretches of alluvium which are a peculiarity of that region. These floods are very uncertain; the river may come down once, twice or three times in a year, but some years it does not flow at all. Much of the soil of these flats is covered with the well known white efflorescence denoting "brak" ground, and extensive vloers or salt-pans, which exist there, are natural depressions *in* the alluvium, which get filled with water during floods; they rarely have outlets but are emptied by evaporation. When a layer of dissolved salts remains spread over the bottom, each following flood adds its quota of salts, consequently these vloers become inland lakes of salt water.

This white saliferous and alkaline deposition is generated in the same manner in many places along the river valley, where it permeates the soil to considerable depths.

To ascertain what proportion of the rainfall is discharged by our rivers a series of close scientific observations should be instituted. The Mississipi is said to discharge one quarter of the rainfall into the sea, the Elbe one quarter of the rainfall, the Seine at Paris carries off one-third of the rainfall. In Great Britain from a fourth to a third part of the rainfall is perhaps carried out to sea. The writer has calculated the probable discharge of the three rivers he has specially mentioned, allowing one-third of the yearly rainfall as the quantity which finds its way into the ocean. From the table attached to Mr. Gamble's paper on the rainfall of South Africa, read in 1878, Aliwal North, Concordia and Keerom, three stations within the drainage area of the Orange River, show 25, 9 and 8 inches respectively, which gives a mean of 14 inches. Clanwilliam show 10 inches and Stellenbosch and Malmesbury 23 and 19 inches, or 21 inches as the average. By this, the only available data, the discharge of the Orange River is equal to 3,220,000,000,000 *cubic* feet, the Olifant's 100,000,000,000 cubic feet, and the Berg River 65,000,000,000 cubic feet per annum respectively. But in connection with their discharge the geological and fertilizing actions of our rivers are of equal importance, the latter if utilized would become a source of riches. The greater part of the mineral matter held in solution by the Orange and Olifant's Rivers in floods is taken up from the Karoo plains.

It is to be regretted that these vast carriers are allowed to transport their riches to the ocean, instead of distributing it over the dry and parched lands through which they flow.

Many of the tributary rivers when swollen are rolling currents of mud sisting as much of sand as water, and when the flood is great enough cause an overflow, the reduced velocity of the scattered waters induces ettlement of this rich silt. During the writer's visit to the Clanwilliam trict he measured various strata of silt and found them to vary from o 6 inches in thickness.

The Olifant's River has so deepened its bed and eroded its banks that area of the waterway is now much greater than it formerly was. Fifty rs ago overflows were of annual occurrence, now they do not take ce at all, hence the poverty of the farmers along its banks.

The Berg River deriving its water principally from springs, not from smodic tributaries, changes its features at a considerably slower rate an either the lower Orange or the Olifant's Rivers.

The deepening and widening of river beds by erosion in this colony ry often proves disastrous to the dwellers on their banks; first, by acing the water they require for agricultural purposes beyond their ach; secondly, by the destruction of the fringe of forest which usually rders them. The banks get gradually covered with sand brought own by the river, which when it becomes dry is blown into sand dunes, rming a nucleus upon which the wind operates to blow it over the elds in every direction. Now the average specific gravity of the stones n a river ranges between two and three times that of pure fresh water, ence when they are borne along they lose from half to a third of their eight in air, and any observer may see in rivers which have their ourse through rocky and mountainous tracts huge stones, which could ot be moved by the same amount of impetus on dry land, that have been transported far down from the point where they were originally in situ. Heavy falls of rain add enormously to the transporting power of rivers; a constant fall of several inches fills all the hollows and rivulets within the drainage area; each tiny stream washes up and carries with it a certain amount of soil and gravel to the tributaries, which in their turn erode and convey a greater proportion to the river, which soon becomes a turbid flowing mass.

The quantity of mineral matter transported by rivers has been carefully measured in Europe, America and India, but the most explicit and accurate results on this subject yet arrived at have been made in America by Messrs. Humphreys and Abbott, the engineers charged with the investigation of the Hydraulics and Physics of the Mississipi. Clear water erodes but little, hence the wearing away of the banks and deepening of channe's in our South African rivers is the work of the detritus carried down in floods. The writer found that the Olifant's River had widened its channel 30 feet in 22 years; this he determined from information obtained from old residents and from measurements taken from the existing banks to old tree trunks, standing well out in the channel, which twenty-two years ago stood upon the bank.

This increased width of channel enlarges the surface area of the floods but lessens their vertical height. The banks being eroded, as a natural consequence, the strips of forest are destroyed which acted as screens to keep the heavier and less fertilizing portions of the silt and detritus in

the river, allowing it to collect on the top of the banks, adding to
height and aridity.

To obviate this deterioration I would suggest that massive da
loose rubble be thrown across rivers possessing characters of the a
description, such as have been built across the Jumna, Ganges
other Indian rivers for irrigation; this would effectually raise the le
the river beds and moderate the velocity of the flow. The distance
the sill of each dam to the toe of the one above it would in
become an artificial lake of comparatively still water. One result
be the silting up of the river bed, and the banks no longer being su
to erosion would become eligible sites for tree planting along the
length within the influence of the dams. This system of moder
the flow of rivers might be advantageously carried out on a smaller
on the tributaries. Those which are silt bearing would enrich the
tiguous farms, and those tributaries whose sources are high up in
mountains, where rock and boulders are plentiful, could be effect
weired up in the narrow parts, their waters being led out to fertilis
sides of the valley below each dam. Moreover the destructive denud
and erosion carried on by these mountain streams and torrents would
reduced to a minimum.

In recommending this system the writer speaks not without pre
dent, or authority, as to its ultimate economical effect. Provinces
India, the physical features and character of which resemble those
South Africa, have become wealthy and prosperous under British r
through having their rivers and streams dealt with in this manner.

There has as yet been very little done for the meteorology of So
Africa, and next to nothing is known of the Hydraulics and Physics
our rivers. The Government has established observing stations in ma
places throughout the colony, but meteorological and hydraulic obse
vations to be of much use should be prosecuted on an extensive sca
The drainage areas of our principal rivers and tributaries should b
closely and thoroughly observed. Rain gauges might be placed with
them on the crests of the watersheds, the prominent faces of the slopes,
and in the bottom of the kloofs and valleys, and if they are attentively
and carefully watched a very close approximation to the amount of rain-
fall would then be obtained.

Then again the rivers and large tributaries should be ganged in
several places and a record kept of their flow; by these means the pro-
portion of discharge to rainfall might be arrived at. The water pass-
ing during floods and flowing perennially should be analyzed to ascertain
the nature and quantity of minerals carried in suspension, as well as
what is chemically dissolved, and what is driven along the bottom.
The slow but progressive changes in the channels and deltas are to be
noted. If this work is scientifically performed the transporting capacity
of a river can be obtained, and previous to any great work being started
for the improvement of our rivers, these operations should be carried
out. To examine and report upon a river, and its facilities for irriga-
tion, navigation and general improvement, without being in possession
of correct data, is groping in the dark.

XII. ON PERIPATUS CAPENSIS.—By H. W. Oakley.

[Read 30th May, 1883.]

he Peripatus is not new to Natural History, or to the South can Philosophical Society, but it is of very great zoological interest, ing near one of the main stems of the great zoological family tree, oseley says in his memoir read before the Royal Society on the 21st , 1874. So that I offer no apology in again bringing it before you, cially as I have gained during many recent Peripatus hunts, to ain specimens for Mr. Adam Sedgwick, M.A., of Trinity College, nbridge, some facts which I think may prove of interest.

For those who are strangers to the Peripatus a short introduction y be necessary as regards its general characters and habits.

The Peripatus belongs to the group of animals termed the *Peripatidea*, l they in their turn belong to a division of the Annulosa known as Arthropoda, in which also are placed the Crustacea (Crabs and bsters, &c.), Arachnida (Spiders and Scorpions, &c.), Myriapoda ntipedes, &c.), Insecta (Butterflies, &c.).

The Peripatus has a distinct head, which is provided with a pair of ny jointed antenna-like tentacula, and two simple eyes. The mouth, uated upon the under surface of the head, is surrounded by a promi- nt lip, which encloses a pair of jaws, each of which is terminated by o curved chitinous claws, similar to those of the feet. On each side the mouth, the head supports a short obscurely jointed oral papilla, hich is somewhat like one of the feet, but is devoid of claws and per- rated at its extremity. The head is followed by an unsegmented body oduced laterally into paired appendages, which vary in number from urteen to more than thirty, according to the species—the Cape species as 17 pairs—and each of these appendages is indistinctly articulated, he terminal joint being provided with two small curved claws.

These creatures vary in colour, some being black, others brown, and thers again dusky brick red—all have a narrow black dorsal stripe.

The Peripatus has the peculiar habit of ejecting from its oral papillæ —when irritated or handled—a web of transparent viscid filaments, which become rapidly indurated.

The great power of extension of the body is very remarkable, it being able to stretch itself more than double its ordinary length. It walks very much like a caterpillar, and moves easily either forwards or backwards.

Several species of Peripati are known from the West Indies, South America, New Zealand and the Cape.

They live in damp shady places under stones and in decaying trees.

I have found the Cape species under stones, and beneath the bark and in the woody tissue of the Oak, Poplar, Willow and Pine.

It is found on the Flats, though sparingly, becoming more plentiful on the slopes of Table Mountain.

Its food apparently consists of decayed vegetation.

The first Cape specimens were found many years ago, Mr. Trimen, F.R.S., being one of the first to discover them, but little appears to have been done with regard to the anatomy of this creature until Mr. H. N. Moseley, who came to the Cape as Naturalist to the *Challenger* Expedition, found some specimens at Wynberg in a plantation surrounding the house of Mr. Maynard, situated just behind Cogill's Hotel.

It was from these specimens that Mr. Moseley obtained the material for his Monograph on *Peripatus capensis*, which I have before stated was read before the Royal Society of London on the 21st May, 1874, but which as Mr. Moseley states is incomplete, and he left the gaps to be filled by other observers.

Prof. Balfour, of Cambridge, was the next to take the matter up, and on the 10th of April, 1879, wrote to Mr. Trimen requesting him to procure specimens of the Peripatus for dissection, but it was not until some months afterwards—I think in July, 1880—although diligent search was made, that any were found, Mr. Lloyd Morgan being lucky enough to find a good many specimens on the slopes of Table Mountain near Rondebosch. These were sent to Prof. Balfour, who obtained valuable information from them.

Unfortunately Prof. Balfour's untimely death on the Alps a few months ago put an end to his researches, and his unfinished memoir was taken up by Mr. Sedgwick and Mr Moseley.

On the 4th Dec., 1882, Mr. Sedgwick wrote to the Museum for more specimens, but beyond a few collected by Mr. Lloyd Morgan and myself in July and August last year, from which Mr. Sedgwick writes that he has obtained some valuable embryos, it was not until the 29th April last that I and my brother and Mr. Richards were fortunate enough to obtain a good many specimens in the neighbourhood of the Waterfall Gorge, Rondebosch ; and much to my surprise we found many newly born young ones, the breeding time hitherto having been supposed to be from the end of July to December.

Some of the adult specimens obtained I placed in boxes ; but the first to bring forth young in captivity was one obtained by Mr. Richards, which he found during the Peripatus hunt with me on the 29th April.

This Peripatus has given birth to 19 young ones, viz. :—

2 on 2nd May
4 „ 4th „
7 between 4th and 8th May
1 on 21st May
3 „ 25th „
2 „ 28th „

—

19

The next Peripatus to give birth in captivity was one that I found under a stone on 3rd May.

She has produced 23 offspring, viz.: on 6th May she gave birth to

4	young ones
2	on 7th
4	„ night of 7th to 8th
4	„ „ „ 8th to 9th
2	„ „ „ 9th to 10th
3	„ 10th
3	„ 16th
1	„ 21st
23	

The young Peripati vary in length from 6 to 9 lines; they are of a ale livid red with a central dorsal and two lateral grey streaks; the ntennæ are also grey.

There are 17 pairs of legs as in the adult, they are of a grey colour. At the base of each antenna there is a bright conspicuous eye. When born the young Peripatis are undoubtedly quite of the adult form, and when irritated eject from their oral papillæ the web of viscid filaments precisely in the manner of their parents.

On placing an infant Peripatus in strong spirit it immediately ejects the filaments, resembling in this respect the adult; and on dissecting one I found the glands which secrete this liquid to be well developed.

A small sized Peripatus produces young ones different in size and colour to those of a large or moderately large one; for instance, the one in the small bottle has given birth to eleven, and two others in the tin boxes before you to 5, and the other to 5 young ones varying in length from 3 to 4 lines.

They are of a pale pinkish colour, and the legs, of which there are 17 pairs (as in the adult), do not differ but slightly in hue from the body; the antennæ, however, are decidedly of a darker colour. The dorsal and lateral lines are less distinct than in the young specimen of the larger Perapiti. On irritating these very small infants I find they eject the viscid liquid in a similar manner to the adults.

XIII. THE BEAUFORT DAM.—By A. B. Brand, C.E., of Beaufort West.

[Communicated by the President. Read 30th May, 1883.]

Before entering upon a description of the Beaufort dam, a brief allusion to the original water supply of the town may not be uninteresting.

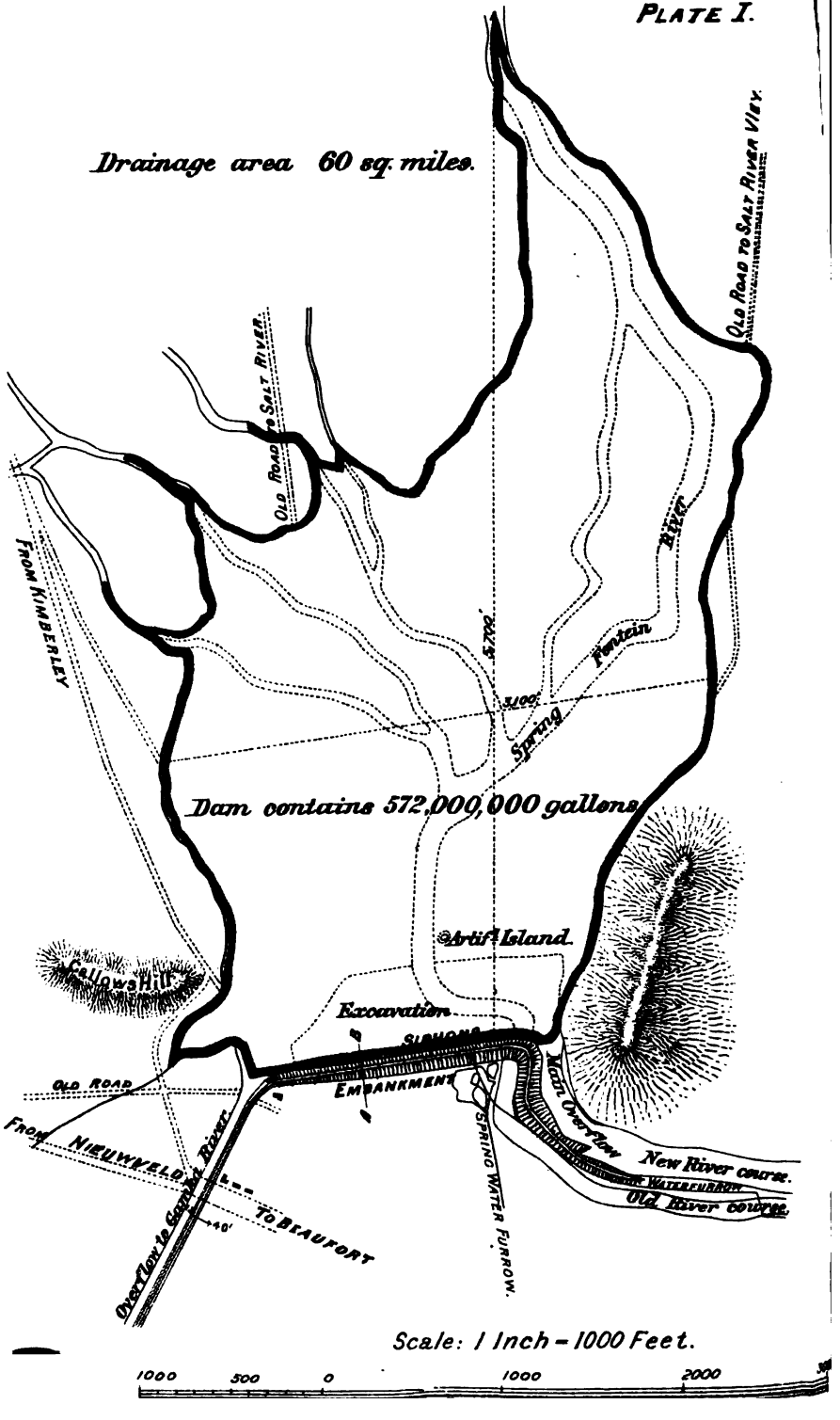
A feature to which I wish particularly to refer is the Greenstone Dyke, crossing the upper part of the town in a line with the two ridges adjoining, which latter form the "kloof," in which the original village was laid off. This dyke is one of many of a similar kind traversing the Karroo in every direction, and forming subterraneous dams or walls, offering in many places, where breaks or neks occur, excellent sites for storage reservoirs. Generally at such places springs are to be found,

either on or near the surface; as instances of the former in this locality, I may mention the Springfontein and Gamka fountains, as also the well-known springs at Rhenosterkop, Nel's Poort and Salt River. Previous to the construction of the Beaufort dam, the town water-supply was solely dependent on the two springs first named, the joint yield from which varied from 26,000 gallons per day in dry seasons, to 99,000 gallons per day in good years. The droughts here are occasionally very severe and protracted, so much so that it was by no means unusual for the dwellers of the town to lose their land and garden crops, and even fruit trees. On such occasions the springs became so weak, that even with their whole yield turned alternately into each of the three furrows, the water could only reach half way down the town, and it became necessary to carry water from the natural dam for domestic purposes.

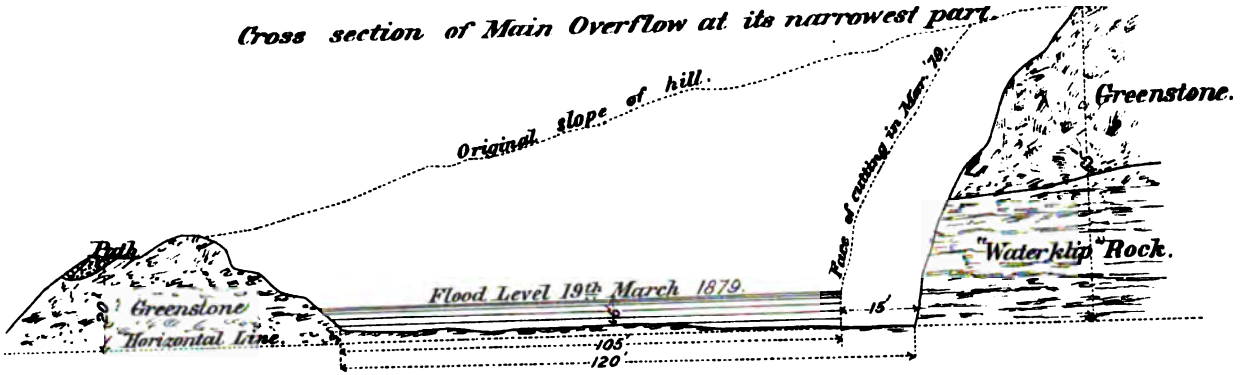
In order to improve the supply of Beaufort West several methods were proposed and discussed, the three meeting the most favour being:—

1. The lowering of the dyke forming the natural dam, together with the bed of the furrow leading therefrom into the town, with the object of reducing the pressure on the feeding springs and consequently increasing their flow; this, would, however, have necessitated blasting, which was objected to, on the ground of its being likely to rupture the dyke, rendering it both leaky and less secure during heavy floods; moreover, the lowering of the furrow would have entailed heavy expenditure on the part of certain "erf-holders," in reducing the evel of their erven to the proposed altered level of the furrow, hence this scheme was abandoned. The second, on which action was taken, was the construction of the weir (if I may so call it) across the river channel immediately above the natural dam, the intention being that the head of water falling with force over the weir should scour out the heavy lodgment of silt from the then existing small dam, and thus give free vent to the feeding springs, the more powerful of which lies some 20 feet below the normal water level of the dam. Unfortunately, this weir was built of water-worn boulders in clay mortar, with a kind of mud hearting, and had a cross-section even less than an ordinary Boer dam, with no foundation, so that I need hardly say that it only awaited the first run of the river to be destroyed. The third plan was an endeavour to raise the water from the dam by means of an Archimedean screw, but this was soon abandoned, as the necessary manual labour was both expensive and not always procurable, and more especially as the screw was found practically to be a case of "robbing Peter to pay Paul." So far as I can discover, no attempts were ever made to open out the springs. Some are comparatively superficial. This, however, need not be regretted, as judging from the water level in the numerous deep holes washed out of the water bearing strata, at the bursting of the Beaufort dam in 1869, agreeing as it does with the water level in the several wells lately dug in the same locality, it would appear that the strata referred to bear against the greenstone dyke in a level line right across, and that while water is found at every spot hitherto tried above the dyke at the same level, plus or minus the rise or fall of the surface ground level, yet in no instance has it been found to be under

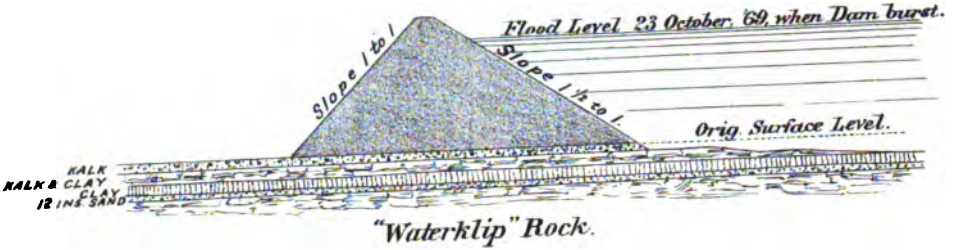
PLATE I.


Drainage area 60 sq. miles.
Old Road to Salt River View.
Old Road to Salt River.
From Kimberley
Spring
Fontein
River
Dam contains 572,000,000 gallons
Artif. Island.
Gallows Hill
Excavation
Sluices
Old Road
Embankment
From Nieuwveld
Overflow to Sandy River
To Beaufort
Spring Water Furrow.
Weir Overflow
New River course.
Waterenbron
Old River course.
Scale: 1 Inch = 1000 Feet.
1000
500
0
1000
2000

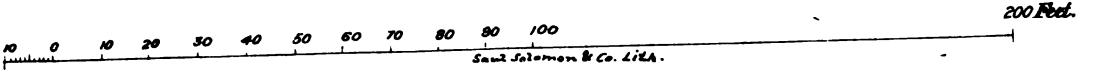
Cross section of Main Overflow at its narrowest part.



Cross Section of old embankment.

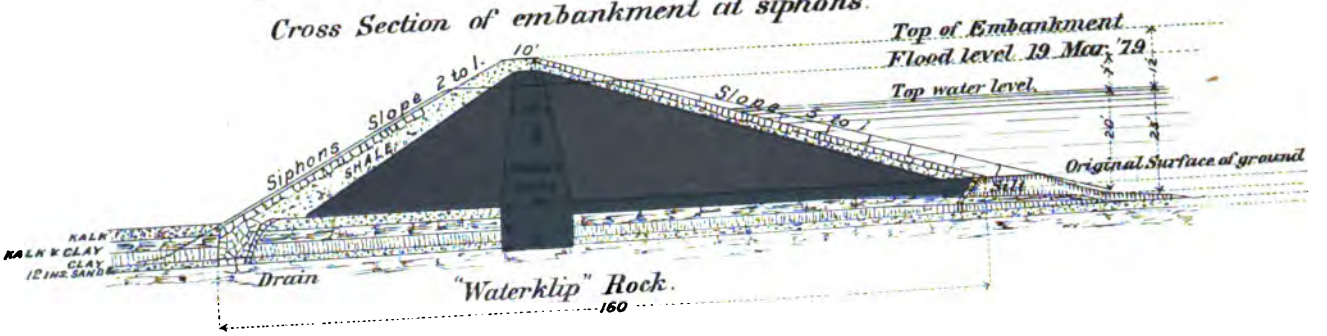


Scale: 1 inch = 40 Feet.

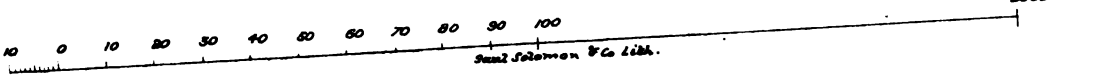


Cross Section of embankment at A. B.

Cross Section of embankment at siphons.



Scale : 1 inch = 40 Feet.



reasure, so that the opening out of the springs—much talked of as a emedy some ten years ago—would not have been successful. Besides, s experience has often proved, the operation has—although occasionally uccessful—been generally the reverse, and is always a very delicate nd dangerous experiment. Of course, these remarks do not refer to ny operation with the spade, pick or crowbar. It has been found a much preferable and safer plan to protect and lead out spring-water by means of pipes. By such an arrangement, say an 18-inch pipe, so laid as to collect and conserve the water, the yield of the powerful Gamka spring might have been quadrupled, at least.

After many public meetings have been held, the bold idea of constructing an earthern dam across the Springfontein River above the town was considered and agreed upon after some little opposition. The usual and very necessary preliminary steps were I fear not taken, and I have been informed that the alignment of the embankment, its length, sectional area, the position, nature and discharging capacity of the overflows, and distributing outlet—in a word the designing and carrying out of the works were entrusted to two members (non-professionals) of the Municipal Board. I am not certain either as to the date of starting, or of the completion of the works, but can recollect witnessing on the 16th December, 1867 (shortly after my arrival in Beaufort), the first run of the river into the new dam, filling it to the extent of 16 feet in the excavations and 10 feet against the made bank, at the deepest part. The rejoicings natural on such an occasion were somewhat marred on observing the considerable leakage which almost immediately took place at the base of the embankment in several places. A few days after, a dangerously looking leak was discovered near the distributing pipe, upon which, at the request of the Magistrate, Captain Tinley, I prepared and forwarded to the Hon. R. Southey, Colonial Secretary, a rough sketch of the dam showing the position and extent of the leakage and a few other particulars referring to the unsound condition of the embankment and the want of outlets, &c. The apprehensions generally felt as to the safety of the dam increased considerably with the additional leakage, which resulted from the 2nd run of the feeding streams on the 6th February following, which raised the water to within 4 feet of the outlet level. The Municipal Commissioners, with one or two exceptions, did not seem to share in the general feeling of alarm, and declined calling in professional advice, although repeatedly urged to do so. A serious slip of the inner toe of the embankment below water-level, followed by a corresponding settlement of the slope above, leaving an ugly gap along more than half the length of the embankment, brought matters to a crisis, and a public meeting being held I was engaged to make such surveys, &c., as would enable me to report upon the alleged instability of the embankment, and the best mode of placing its safety beyond a doubt.

The slip in the inner slope having been made up with material rafted on from the ridge, I set to work by surveying the drainage area of the dam, which I found to be nearly 60 square miles—being much more extensive than was supposed—then I carefully surveyed and sectioned the basin of the dam, finding its contents to be (on the 24th December,

1868) 163,000,000 gallons, and its full storage capacity, 500,000,000 gallons There being no raingauge kept in the neighbourhood, I had to be all the more careful in the gauging of the different feeding streams in order to determine the required dimensions of the storm overflow necessary to preserve a safe water-level in the dam for the heaviest known floods. I found the mean of six cross sections of the several feeders with their respective gradients, to compare very nearly with the previously ascertained feeding capacity of the river. The results gave the feeding power of the river (when full to the top of its banks) at 68,333,000 gallons per hour. It rarely happens that this river overflows its banks at the part referred to, but it would be erring on the safe side to allow an additional 15,000,000 gallons per hour for extraordinary floods, making in all 83,333,000 gallons, which quantity would fill the dam in six hours.

On measuring the two outlets I found the one on the southern side had a cross section of 83 square feet, with a gradient of 1 in 10, and the other 60 square feet but practically level; their joint discharging capacity being barely sufficient for the smaller of the three minor feeders.

The embankment had an outer slope of 1 to 1, was 3 feet wide at top. with an inner slope of 2 to 1 where it crosses the river, thence the inclination gradually blended into 1½ to 1 up to its northern end. An examination of the embankment showed—besides the leakage and slips before referred to—several large fissures running in a zig-zag line along the faces of the bank, and a series of vertical or rather oblique cracks generally found at the joints in the layers of earthwork—which were evidently neither carried out in continuous sheets nor were the layers incorporated into each other at the breaks. A line of levels taken along the top of the embankment (which was presumably level or nearly so originally) showed considerable unequal settlement throughout, the portion where the dam eventually breached being 17 inches below the general line of the top line.

No foundation trench had been excavated, nor had the vegetable matter (bushes and their roots) with the pulverized soil and silt been removed from the surface, which latter, the silt, when acted on by water is likely to run into quicksand. No borings were ever made to ascertain the nature of the soil beneath the base of the embankment, and no berm or terrace left between the inner toe of the embankment and the line of excavations. A naked pipe had, moreover, been placed through the embankment on the made ground, which pipe was jointed with oakum and white lead! and a permanent spring had been banked over in the river bed, without being carried away in proper drains securely puddled, the effect of the attempt to choke the spring being to render that portion of the base of the embankment, to a height of 16 feet, in a semi-fluid state.

The conclusion I could hardly help arriving at, was that the dam was in a dangerous condition and that it might indeed break at any moment, even with the then low water level in it; but on my reporting accordingly to the Municipal Commissioners I failed to convince the majority of them of the necessity of taking immediate steps to endeavour to avert the impending danger.

In my report then read, I strongly urged that, as a preliminary step, the dam be emptied by lowering the southern outlet, to enable the necessary alterations and repairs to be effected. The first—the outlet cutting—was estimated to cost £900, but the nature and extent of the proposed repairs—entailing a remodelling, indeed, a reconstruction of the whole embankment, which together with providing sufficient storm overflows, making the means of egress equal to the means of ingress during the heaviest floods, would have cost £8,000, or say £9,000 in all—caused great consternation and dissatisfaction. The principal reasons advanced by the Commissioners, who opposed action being taken, were :—

1. That the dam was of much greater capacity than my plan indicated. (I had shown the perimeter of the dam, when full, by erecting 32 beacons in the basin at the outlet level.)

2. That my notions of the feeding stream were more applicable to the Orange River.

3. That as the dam would probably never get full, no further outlet capacity was necessary, and moreover that there was a natural nek, which had been found by a mason's spirit level to be about outlet level (I had made it with the theodolite 8 feet above outlet level), would act as a natural overflow ; and so forth.

Shortly after, another public meeting being threatened, the Municipal Commissioners resolved on making a start to the lowering of the outlet, by cutting a drain through it 3 feet by 5 feet, their view being thereby to ascertain the approximate cost of carrying out the whole cutting as recommended by me. This small drain was carried out by contract for £200.

On the 22nd October, 1869 (by which time the dam was nearly empty), a heavy thunderstorm burst in the drainage area of the dam, followed by a heavy shower the next morning ; a rough raingauge I had constructed gave the fall at 3·05 inches for the 13 hours. At 10 o'clock a.m. on the 23rd the dam ran out for the first time, and all the feeders being still running strong, the water level in dam rose rapidly. The comparative smallness of the dam and its outlets now became palpably evident to the onlookers, who were becoming much excited and alarmed, for besides the old leakage having materially increased, one new leak on a large scale had found a vent some 16 feet above ground level, which was partially stopped with great difficulty. I meanwhile had advised the Resident Magistrate to warn the town folks of the danger and to clear the town. This was not done a minute too soon, as at noon, when the water was still 5 feet from top bank level, the dam burst, doing, as was publicly recorded at the time, damage to household property variously estimated at from £30,000 to £50,000. Luckily no human lives were lost, but one may shudder to contemplate what the consequences would have been had the dam breached during the night, for throughout the whole length and breadth of the town, the water rushed with great force from three to six feet deep for several hours, all the streets being roaring torrents, undermining and sweeping away houses, trees, &c., in their course, and both rivers (one skirting

the town on either side) tearing down over 20 feet deep, rendering escape impossible.

Towards the end of 1873 it was resolved at a public meeting to "repair" the dam by constructing a weir in the breach, 120 feet long and 15 feet high, above floor of breach.

At another meeting held soon after I was requested to report "on the advisability or otherwise of reconstructing the dam as resolved upon" at the previous meeting, as also "my views as to the best mode of reconstruction." In accordance with which I reported that I disapproved of the weir scheme in the breach, mainly for the following reasons :—

1. The insufficient discharging capacity of the proposed weir.

2. The uncertainty of the primitive or greenstone rock being found ; in my opinion borings would show a water-klip formation, quite insufficient as an incompressible and water-tight foundation, and as the first heavy run of water over the weir would certainly break up and dislodge the water-klip and speedily undermine the weir. The likelihood of foundations being about 9 feet deep (found subsequently to be 8 feet and that the rock was water-stone) would render the work below the ground level very expensive ; and making the actual height of the weir-wall 24 feet. I considered the cross-section of the same much too small. Speaking from memory the wall had an 8 feet base, 4 feet top with a vertical face. The same objections of course held good with reference to the wing walls of the weir, with respect to which, moreover, nothing had been said as to puddling or concrete backing, counterforts, or any other means necessary to render their junction with the earthen bank water-tight (which even under the most favourable circumstances is most difficult of attainment).

3. The scheme did not embrace any remedial measures being taken with the embankment, which, as before described, was in a most unsound condition generally, neither was the removal of the pipe referred to, the plugging of which—as was subsequently proposed—would not of course have prevented the "creep," which I felt convinced had previously existed (and which was of itself a feature so dangerous as to justify the many predictions that the dam would fail there first). Nor was the covered spring in the river bed even referred to, although quite as dangerous, for very similar reasons, as the pipe.

The resolution of the former meeting having been rescinded, I proceeded to state my proposal for reconstruction, in effect as follows :—

1. That the original outlet level be adhered to, giving 24 feet of water in the excavations and 19 feet against the made bank at the deepest part.

2. That the alignment of the embankment be altered as follows :— The line to be retained from the northern horn to breach, thence in a line with the point of the "kopje," the old bank to be removed from the line thus proposed to be abandoned, to assist in forming the new embankment.

3. The main outlet to be 130 feet wide cut through the low point of ridge; this outlet would have had an easy funnel-shaped approach on the

inner side, and the overflow water would have been discharged from it in a line nearly parallel with the old river channel, and therefore requiring no breakwater to protect the town; the cutting would have contained 7,860 cubic yards and cost £2,000.

4. The northern outlet to be widened to 50 feet, and cut with a gradient of 1 in 85; the rock and shale therefrom to be formed into a bank on the town side of outlet, the top line of said bank to be 3 feet lower than that of the embankment. The opposite side of outlet to remain clear, to allow flood-water to spread. The sill of this outlet to be six inches higher than that of main overflow.

5. The section of embankment to have a pitched slope of 3 to 1 on inner side and 2 to 1 on outside, with a puddle-core (or back-bone of tough clay) in the centre founded in a puddle trench to be cut down—if necessary—into the rock until an impermeable bed is reached, a foundation to be formed for the inner portion of the embankment by a sheet of puddle being laid from the puddle-core to the toe, terminating by being carried vertically downwards into some retentive stratum. The outer slope to be protected and sustained by a strong wall 15 to 19 feet thick at base, and 3 feet at top, composed of rubble-stone and shale brought from outlet cutting. The wall to be founded on the rock in such a manner that the foundation trench would act as a drain for carrying off rain water from outer slope, together with what might possibly be found to percolate (for a short time until stopped by silting) from under the puddle-trench through the fissures of the rock—which in some parts had been exposed by the excavation being carried too deep.

6. The portion of the outer-slope of the embankment in the river covering the spring to be opened to the fountain-eye, and the water led out by means of a culvert securely puddled; two lengths of the pipe on the outer and three on the inner side to be removed, the remaining lengths to be filled with concrete well rammed, then the ends plugged and the trench carefully puddled up. The irrigation supply to be drawn off by means of two 3-inch siphons, which by being placed over the bank would not in any way endanger it or disturb the continuity of the puddle and earthwork.

7. The top line of embankment to be 10 feet above level of sill of main overflow.

The estimated cost of carrying out the above scheme was £9,800; but as this was considered too high, and objections being made to any interference with the embankment in the river-bed, I was requested to reduce the "dam" to 15 feet, and to limit the expenditure to £3,500.

This request was, however, "easier said than done." Safety demanded that the pipe and covered spring be dealt with, which could only be done effectively in the manner previously described. The small money limit precluded any scheme embracing the necessary alterations to the embankments and outlets; moreover, the lowering of the latter to the level resolved upon would have materially increased the amount of green stone-work cutting, and consequently the cost thereof. Under all the circumstances, I could only report that the carrying out of the resolution was neither practicable nor advisable, and that if the 15 feet

dam was adhered to, it would be found only capable of storing a seven-months' supply, and the end of autumn would generally see it empty—just the time when the greatest water supply is necessary for the crops, a second crop being, unless in exceptionally good years, out of the question.

In view of the ever-increasing requirements or necessity of something being done, I subsequently sent the Commissioners the following suggestions:—

1. That the old river channel be opened, the earth therefrom to fill up the breach.

2. That a weir be constructed across the river-channel on the green stone rock, 200 feet long, well bonded into the kopje at the one end, with wing-walls at the other where it joins the embankment; a 9-inch distributing pipe being built through weir-walls twelve inches above the river bed; the wall being constructed, in the first instance, fifteen feet high, but with a sufficient cross-section to enable its being heightened another five feet, or lift, when found desirable.

3. That the embankment be thoroughly remodelled, as previously described.

No action was taken until about the middle of 1874, when, after several engineers had been consulted, the public resolved on carrying out my original scheme, with the exception of the proposed alteration in the alignment of the embankment, the original straight line being preferred by the public on account mainly of its keeping the "drink-water fountain" free. A start was immediately made (under my supervision) with some 25 convicts, to the outlet-cutting on the town side. By the end of the following year (1875), with an average number of 59 convicts engaged, 6,750 cubic yards in all had been removed and formed into the breakwater. Towards the end of the year Mr. Gamble, at the request of the Hon. Commissioner of Crown Lands and Public Works, inspected the works, and in his report, dated 14th December, 1875, expressed himself satisfied both with the design and the manner in which the repairs to the work had so far been carried out. His visit was very opportune, as by his advice siphons were finally agreed upon, the question of puddling the whole embankment settled in the affirmative, and light thrown upon several other important points affecting the stability and permanency of the embankment.

In March, 1876, a start was made to alter the inner slope of embankment. I found it necessary to remove a large quantity of silt before founding the new earthwork by laying the puddle sheet already described. The pitching stones having been removed, the slope of the old bank was cut or "racked back" in steps, with a vertical niche (for toothing) at intervals of 25 feet, cut from 3 to 5 feet into the bank. In so doing I could perceive the mistakes made in the construction of the old embankment—not before discernable—as follows:—

1. The base and lower portion of the embankment to the height of 10 feet was barrow-work, with no wetting or ramming.

2. Earth not spread in regular layers, often varying in thickness from 2 to 5 feet, and occasionally found dipping towards the inside.

3. The evils attending high tips showed themselves by the small stones and lumps of hard ground having rolled down the slope and settled in a heap at the bottom; these became covered, and a new layer deposited as the work progressed, and so in the end a layer of very porous material was formed under the whole extent of the work, leading the water into the heart of the embankment. The impossibility, too, with thick layers of obtaining equal consolidation—the result being unequal settlements and slips.

4. The five different kinds of soil composing the embankment had evidently been ridden on without first being assorted or mixed in the proportions necessary to render it—with proper wetting and ramming—impermeable, so as to form a water-tight bank. These strata of soil, &c., available, were as follows:—(1) a deposit of calcareous tufa called locally "kalk"; (2) an admixture of the latter with loam; (3) brown clay; (4) water worn sand and pebbles; (5) blue shale. None of which alone (not excepting the clay, which was of itself too rich) would form a good bank. The facing-stones, being generally pretty large and round, with no packing nor stratum of shale or broken stone between them and the earth, laid as they were on a $1\frac{1}{2}$ to 1 slope, allowed the waves in stormy weather to commit great havoc by washing out the earth from under the stones, thereby causing serious irregularities of the surface.

In altering the outer slope, I also "racked" it back in steps, and by carrying up the rubble and shale wall simultaneously with the new earthwork, thus preventing the spread of the earth laterally, greatly assisted the carts and rammers in consolidating the work. The same process was carried on in the inner side, and by spreading the soil in layers never exceeding 3 inches in thickness (with a slight dip inwards towards the puddle-core), then thoroughly rammed down while moist to a uniform thickness of 3 inches, I found that with the earth mixed in certain proportions, determined by experiment, good work could be done.

Nature favoured us in providing a stratum of, for the colony, very good clay near the works for puddling. This clay was first dug and prepared by cross-cutting and tempering at the place where dug, then brought on and spread in thin horizontal layers, not exceeding 5 inches or 6 inches in thickness, beaten down to 3 inches, each layer being carried out to its full extent and incorporated with the preceding one before another is laid. This mode of procedure gives the best puddle if well superintended, the clay getting more frequently turned over and there being less danger of too much water being used, producing mud instead of puddle. Strong side planks were used to prevent lateral expansion of the clay while being punned down. The puddle wall is supported on each side by selected material averaging 6 feet in thickness, which was also well watered and rammed.

The puddle wall is bonded to the extent of 25 feet into a niche cut in the centre of the old embankment on each side of the breach, and is also toothed in from 3 feet to 6 feet at intervals of 8 feet between the puddle-core and the inner toe of the old embankment, so as the better to amalgamate the new with the old work.

On examining the pipe-joints I could plainly perceive that all I examined had leaked; there were, too, ample evidence of the "creep" along the pipe. On cutting open the outer toe of the embankment in the river I found the spring, which had then a yield of 39 gallons per hour. This I drained out in the manner already described.

The cutting of the puddle trench gave ample proof of the absolute necessity of trial pits being made to ascertain the nature of the ground on which the embankment will be placed, and through and into which the puddle trench will pass, before commencing the construction of an embankment.

Said trench, besides showing what the sections indicate, proved the "kalk" formation to be only apparently hard and actually impressible, porous and full of water, strongly impregnated with lime and brak. The second stratum was also soft and spongy, while in the breach we discovered an old water furrow in the clay stratum, filled with stone, and which on being opened up was found to run from the original excavations right across the breach in an oblique direction towards the south-west. The infiltration from this furrow, finding its way through and up along the base of the embankment, acting as lubricant, and eventually wetting the whole base and bottom portion of the embankment, accounts I think for slipping and subsidence, which latter, as already stated, amounted to seventeen inches there, ending in the breaching of the embankment. The 12 inch stratum of water worn sand and pebbles was, next, perhaps, to the old water furrow just described, the most dangerous feature of all as affecting the safety of the new dam, for as the excavations extended to it in the basin of the dam, and the river water running through the breach had scoured it open nearly to the outer toe of the embankment, the porous stratum referred to would have certainly drained the new dam if nothing worse had happened, had the puddle core in the trench as well as the puddle sheet and toe not intervened.

I might here remark, parenthetically, on the ample proof of the "leegte" above the town having been in former days a vast lake of which Beaufort Poort was the outlet, the attrition of the flood water having in the course of ages worn down the water-klip rock (which—as can be seen from the outlet cutting—bears against and supervenes the greenstone) to the present level of the dyke.

The works were, about the end of 1877, although not quite completed brought to a termination by the removal of the convicts (whose average number for the last two years had been 85). The expenditure to above date was £12,800, including cost of original dam £3,300. I may safely assert that the greatest economy was practised on the works, nearly all our implements having been made, repaired and dressed on the works, the only imported wood used being packing cases for repairing barrows, for we discovered that the common mimosa thorn wood, when cut at the proper time and seasoned, made excellent hammer and pick handles, barrow-wheels and frames, and that with practice and the aid of borax our steel drills, on becoming too short, could be welded, thus effecting a considerable saving in steel.

I found that the Hottentots when trained made excellent strikers, and, when well superintended, good puddlers, Kafirs being better adapted,

on account of their finer physique, for crowbar and pickwork and wall building, while Korannas and Bushmen, as a rule, were both lazy, useless and intractable.

The first run of water—about 13 feet deep—took place on the 3rd Oct., 1877. During the following year it was several times replenished but only filled for the first time in January, 1879, when the water ran 22 inches deep through the main outlet; in March soft rains fell daily from the 1st to the 13th, thoroughly saturating the whole drainage area, and culminating in the heaviest and most protracted rainfall recorded in this locality. On this memorable occasion the rain fell heavily for 38 consecutive hours, the rain-gauge recording a fall of nearly 6 inches, 3·15 inches of which fell during the first 10 hours. It was observed with satisfaction that although the feeding streams were all overtopping their banks very considerably the water-level in outlets did not exceed 4½ feet. About 11 o'clock on the 19th the water-level suddenly rose—within 40 minutes—another 2 feet, causing great excitement; the water began to overtop the low bank skirting the northern outlet on the village side, and it was resolved to cut a portion of this bank away to assist the outlets; before this could be carried out to any great extent the water-level showed signs of, and was reported to be, falling. By sundown that evening all danger was over, the flood water having gradually become reduced to a flow of 37 inches deep in the main overflow. The sudden increase of 2 feet water in the dam, above referred to, was subsequently found to have resulted from three different dams situated above our dam in the same drainage area having simultaneously given way by the water overtopping their banks.

I must not omit to mention that shortly after the dam filled for the first time a small oozing appeared issuing from the rock behind, but close to the outer toe of the embankment, which although perfectly clear filtered water, differing greatly from the water in dam, which was then brown with the mud in suspension, and evidently a mere trickle through a fissure of the waterklip rock, caused some alarm.

One of the Municipal Commissioners, with more zeal than prudence, started, during my absence, a large work party to cut open a ditch into the inner slope of the embankment. Commencing about 18 inches above the water level they dug vertically down to the surface level or base of embankment. Although this cutting was made in front of the puddle work, the embankment was found, to their astonishment, to be perfectly dry and free of cracks, this fact proving the cause of the alarm to be a mere percolation passing through a fissure of the "waterklip." At any rate it soon stopped of its own accord, and being no doubt silted up has given no further trouble.

As a provision against the breaking of dams higher up the valley, I was instructed, and at once set about carrying out additions to the outlets. I also macadamized the whole length of the embankment with small rubble stone rendered compact with fine shale and gravel, thereby raising the top line another 2½ feet throughout.

The top line of the embankment falls slightly from east to west, so that any overtopping would necessarily take place first at the west end

thereby saving the higher, more expensive and dangerous portion, should such a dire contingency ever occur.

The works were finally completed in February, 1880, at a cost of £13,800.

The direct revenue at present derived from the leased new erven amounts to nearly £1,000 a year, and the indirect benefit accruing from the reservoir in having at least quintrupled the spring-water supply feeding the three town furrows (thereby greatly improving the health and comfort of the inhabitants, as well as materially increasing the returns from the town erven), is estimated by some to be even greater and more important than the direct revenue above mentioned. Of one thing there can be no doubt—that with the remarkably dry five last years, with an average annual rainfall for that period of only about nine inches, Beaufort must thank the dam for meeting without stint and with great gain to the town the heavy demands made upon it.

XIV. AN ENQUIRY INTO THE CAUSE OF THE CAMP FEVER OF KIMBERLEY.—By J. H. Meiring Beck, M.B., M.R.C.P.

[Read June 27th, 1883.]

There are probably few who have ever lived in Kimberley who will *not* agree with me when I assert that the "Camp Fever" has been a serious impediment to the development of the place. This being so my enquiry into the conditions causing it is important. A clear knowledge of its causation might in many cases induce people to avoid unnecessary exposure to risk of infection, or might suggest means of prevention, or might remove much of the insecurity which of necessity must exist in a community that knows not where to look for an enemy as effectually hidden from most as it is dangerous to all. Many theories have been advanced as to the cause of the camp fever, and perhaps none more "even by medical men themselves" than the bad sanitary condition of Kimberley. A moment's reflection will, however, show that this is not so. While recognising the influence of the bad sanitary arrangements existing here and there in Kimberley, in lowering the healths of individuals, and so not only predisposing them to risk of infection but also aggravating symptoms, I cannot regard this condition as the cause of the fever. The influence bad sanitation exerts on this fever is, I believe, not more than it would exert on any other fever. We can understand how bad sanitation, while unable to cause such a disease as, for example, "scarlet fever," might be able to aggravate an attack, and render it more serious. As a matter of fact, with the exception of one or two localities in Kimberley, the sanitary condition of the place is, while leaving much to be desired, not worse than the sanitary condition of many other places in the colony, certainly not worse than Cape Town; and clearly, if able to cause such serious epidemics in one place, it should

lso have the same effect in others. Moreover, such diseases as typhoid ever and diptheria are not uncommon in Kimberley, and we know ufficient of the etiology of these fevers to justify us in declaring them o be due to such bad sanitation as may exist. It is unreasonable to ather all conditions that may arise on bad sanitation, and I think I shall be able to make it clear that a far more satisfactory and feasible explanation is possible. Let me, however, not be misunderstood, and let it be not inferred from what I have just said that I under-estimate the necessity or the value of good and effective sanitation. All that I wish to lay stress upon is that, while recognising bad sanitation as a predisposing cause, I cannot regard it as the direct exciting cause of the fever. In order to convey clearly what is to follow, let me briefly indicate what I believe to be the nature of the camp fever. I believe it to be a malarious fever pure and simple. I think sufficient of my brother practitioners at Kimberley will at the present time agree with me on this point to render an exhaustive argument in support of my reasons for saying this unnecessary. I, however, wish to be clear about it, for only as recently as a year ago, while discussing the matter with one of the leading medical men at Kimberley, my suggestion as to the "malarious nature" of the fever was dismissed by him with the remark, "And where are you going to get your malaria from?" Many circumstances have induced me to regard it as such: its undoubtedly remittent type; its strict analogy to the bilious fever of India; the effect it has on organs we know to be preferred by the "malarious bacillus" (*e. g.*, the spleen and liver); its co-existence in many cases, as in India, with dysentery; the fact that it assumes often an anomalously intermittent type; the influence of certain remedies that we all regard as antidotal to malarious poison; its sequelæ, such as rheumatism, &c.; these and many other considerations have induced me come to the conclusions I have. It would take me too much out of my way to enter more fully into this matter. All I wish to indicate here is my belief, as stated above, in the malarious nature of the fever. What I propose to discuss at greater length is an explanation of the conditions giving rise to the development of the poison causing it. Personally I have entertained the theory I am about to propound ever since I first had an opportunity of studying the disease, and so convinced am I that I am right, that it has become to be regarded by me not as theory any more but as fact. Most minds associate the development of malaria with marshy places, containing organic matter such as *e.g.* decaying vegetable matter: and the total absence of undue moisture from Kimberley, as well as excessive organic matter, no doubt is the reason why for so many years no clear idea on the subject has been arrived at. Let this fallacy be once and for all dismissed from the minds of all here—for the development of malaria neither much moisture nor much organic matter is an absolute necessity. Many, and I have no doubt even some medical men, will be inclined to differ from me; I am, however, happy in being able to refer them, in support of this statement, to an admirable paper on malaria by no less an authority than "Conradi Tomasi Crudeli," which was reprinted from his official report to the Italian Government in the *Prac-*

titioner (vol. 27).* To this authority I am indebted for the satisfaction of many doubts in coming to my conclusions. This is what he says, and I may add that Klebs almost unconditionally agrees with him: "We may regard as well proven facts that—1. The Bacillus Malaria is an organism for whose growth the air is necessary. 2. The germs or sporules of this organism may occur in soils of very different compositions, and sometimes very poor in organic substances. And what is very important—3. These malarial soils may occur in places which are not and never have been marshy."† A little further on he says:—"In all malarial soils and mud a development of the Bacillus Malaria into Sporigerous Bacilli, as well as a rapid succession of several generations of these Bacilli, occurs whenever they are placed under the following conditions:—*a*. A moderate temperature of about 20 deg. Centigrade (68 deg. F.). *b*. A moderate degree of permanent humidity. *c*. The direct action of the oxygen of the air upon all parts of the mass." With these facts before us, how can we apply them to Kimberley conditions? The mine is an integral portion of Kimberley, out of it come daily thousands of loads of diamondiferous earth; on reaching the surface this earth is carried away, and deposited in thin layers on the depositing floors. These depositing floors extend for miles in all directions, amongst houses, and when I left Kimberley a year ago were even beginning to encroach on what was supposed to be the healthiest part of Kimberley—Belgravia. As soon as deposited every particle of earth is moistened and kept moist for days together. This is done in order to encourage pulverisation of the earth, and prepare it for the washing machine, through which in due course every particle is driven, thoroughly saturated with moisture, separated from the contained diamonds, and left as debris in the "wash-up" heaps as they are called. Of these there are hundreds, dotted all over the place, many of them forming mounds of considerable size. Here, then, are all the conditions required above. It has frequently been observed in new countries (notably in Australia) that newly ploughed fields have had the power of generating malaria. Successive cultivations of these fields, it has been found, destroy this power. In this country I have myself observed that fever cases are apt to arise at isolated farms during this season of the year (ploughing season), many of which fevers I have associated with new fields that have been ploughed for the first or second time. In England it has over and over again been demonstrated that fresh railway cuttings have caused malaria. The explanation offered and accepted is that fresh earth of certain compositions, on being exposed to certain conditions, offer a favourable nidus for the development of the Bacillus Malaria. With all this evidence we may therefore assume that it is possible for the "fresh earth" from the mine to possess properties not unfavourable to

* Malaria and the Ancient Drainage of the Roman Hills, by Conradi Tomas Crudeli, *Practitioner*, vol. 27, p. 295.

† This was noticed as far back as 1848, vide a paper published in the *London* October, 21, 1848, on "The Nature of Epidemic and Malarious Fevers," by Sir Jas. Murray. Amongst the most recent of authorities, vide Fayrer's "Tropical Diseases," p. 27.

development of "malarious poison." Now this earth is spread, as have said, on the depositing floor, and here it is subjected to the very conditions mentioned above, viz., it is *a*. Exposed to the sun's rays, which in Kimberley means a temperature often considerably higher than 20 deg. C. (68 deg. F.) (the temperature quoted above as already sufficient for the development of malaria), and we know that in India the malarious fevers become within limits directly more virulent as the places in which they occur have raised temperatures (*Vide* Fayrer's Fevers of India). *b*. It is here kept permanently and moderately moist. *c*. Free action of the oxygen of the air upon all parts is possible. So convinced am I that the cause of the fever is to be searched for here, that I believe it to be capable of experimental demonstration. I had already myself commenced to institute some experiments, in the hope of being able to verify what I have said above. An attack of fever contracted by myself, however, and my consequent departure from the place, prevented me from carrying my intention into effect. For the sake of those interested I may briefly mention the direction I intended my enquiry to take. I proposed to inoculate with earth from the depositing floor, four or five days after exposure, several bottles containing a sterilised fluid capable of supporting organic life, such a fluid as, *e.g.*, beef tea, boiled long enough to kill all contained life. These bottles I proposed after inoculation to expose for about a week or fourteen days to a temperature of about 100. F., in order to allow any organisms introduced with the earth, time and scope to multiply. At the end of the time, I intended to infect the fluid so obtained under the skin of any animal* capable of developing malarious fever, and I should have expected, if my theory were correct, to have produced in this animal an analogous fever. To this test I was anxious to submit my theory. I was, however, prevented. I need not say that I shall regard any attempt from gentlemen who have opportunities of carrying out such or any experiments that may suggest themselves, with great pleasure. But now the question arises, How is it that the same fever existed in Kimberley before the present system of disposing of the earth obtained, in other words, during the "Days of Dry Digging." The above explanation may do very well for the present time, but either it is incorrect or is insufficient to meet all the conditions under which the fever might develope. This question, I must confess, caused me for a long time to doubt the correctness of what I have advanced above, but I believe that I shall be able to offer an explanation quite consistent with what I have already said. And here again let me acknowledge the help I have obtained in coming to a satisfactory conclusion from a study of Klebs' and Tomasi Crudeli's researches. In Crudeli's paper, already referred to, he says that he found in the "Campagna of Rome" that "a very moderate degree of moisture was sufficient to produce malaria. Sometimes soils which are truly pestilential may remain inoffensive throughout a very hot and dry summer, and then all at once give rise to an explosion of malaria after

* Klebs has, I believe, succeeded in inducing malarious fever in the rabbit and Guinea pig. I have no authority at hand, but my impression is that he has done this.

being moistened by a "slight shower." In another part he says "The soil in malarious districts may remain exposed to the direct act of the air during a hot and dry season without causing any danger, may suddenly become dangerous after a very slight fall of rain." another paper* he remarks that "An elevated temperature may pro an outbreak of it (malaria) in soil which is generally incapable of p ducing malaria in such quantities as to give infectious qualities to local atmosphere," and to show how slight a cause sometimes may g rise to malaria, he writes as follows:—"The custom of keeping number of plants in heated rooms may become the determining cause malarial infection, even in localities where malaria is unknown This fact was noticed also by another authority, Professor Eduard v Eichwald, of St. Petersburg, who mentions a case where flower p placed in a heated drawing-room were actually demonstrated to h caused ague in a lady. Now all these facts are important inasmuch with them before us it is not difficult to understand how fever should have developed during the days of "dry digging." During *summer* Kimberley is well known to be visited by severe thunderstorms. This being so there is nothing incomprehensible in the development of malaria under the then existing conditions. The whole population in those days was engaged in digging. The "fresh earth" from the mine, which at that time was not very deep, and directly exposed in *all its* parts to the sun's rays, must often have been moistened quite sufficiently by these thunderstorms for malaria to develop and create epidemics even of considerable severity. Moreover if so moderate a moisture and so apparently trivial a cause as a flower pot in a room can create an attack of fever, then in summer the fresh earth turned up in the confined tents in which people then lived, moistened by rain, must often have been sufficient to induce fever in susceptible individuals. Indeed it seems comprehensible to me that there might have been in the early days of the Fields even more general epidemics than at present; now-a-days many at Kimberley have occupations which reduce the risk of infection to a minimum. In the early days everybody almost was a digger, and as such was constantly in the mine and exposed to risk. All these considerations have practical bearings. If I am correct in what I have said, then clearly correct and definite data will exist for basing our attempts to prevent the periodical visitations that Kimberley has up to this been exposed to. Already I have taken up more time than I should have done, and it is not my intention consequently to enter into any great discussion of the means that have suggested themselves to me for limiting and preventing the fever, or of the curative measures that I have found of most avail. These, perhaps, I may be permitted to communicate at a future date. For the present, let it suffice for me to suggest that recognising the conditions I have laid down as necessary for the development of malaria, preventive measures should be based on methods that might

* On the Generation of Malaria in Flower Pots. *Practitioner*, vol. xxvii, page 387.

agonise these conditions. Knowing, for example, that free exposure he "fresh moist earth" to air and sun is one condition under which aria might develope, means should be adopted to prevent the air sun from getting at this earth more than is strictly necessary, such ans as *e.g.*: The shade and protection of trees, and the planting of ss on all available patches of ground. Knowing that proximity to depositing floors and wash-up heaps means proximity to infecting ntres, some way of running these floors away from the populated parts Kimberley might be resorted to. The directions of winds might be ndied, and risk reduced to a minimum from germs raised from infecting centres by these winds, and carried by them to inhabited parts; when the railway is once as far as Kimberley, families might live ay from Kimberley at Riverton, &c., and so be exposed to less nger. As I have said, however, it is not my intention to discuss this pect of the question just now.

In conclusion, I may be allowed to express a hope that my subject ay have been considered of sufficient interest to the members of the ociety to justify my having brought it before them. In dealing with I have tried to keep before myself the fact that I was not addressing medical audience pure and simple, and I have attempted to develope it onsequently more from a hygienistic than medical standpoint. I incerely hope that I may be regarded as having succeeded in this, and hat I have enlisted by this attempt the sympathy of non-medical as well as medical members.

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THE TRANSACTIONS

OF THE

SOUTH-AFRICAN

PHILOSOPHICAL SOCIETY.

VOL. III. PART 2.

1883—85.

CAPE TOWN:
PRINTED FOR THE SOCIETY BY W. A. RICHARDS & SONS.
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COUNCIL

OF THE

South-African Philosophical Society

FOR 1883—84.

Roland Trimen, F.R.S., F.L.S., F.Z.S., President.*
Hon. C. A. Smith, M.A., Treasurer.
W. H. Finlay, B.A., F.R.A.S., General Secretary.
H. Bolus, F.L.S.
Rev. G. H. R. Fisk, C.M.Z.S.
J. G. Gamble, M.A., M. Inst. C.E., F.R. Met. S.
D. Gill, LL.D., F R.S., F.R.A.S., H.M. Astronomer.
F. Guthrie, LL.B.
P. C. MacOwan, B.A., F.L.S.
Hon. J. X. Merriman, M.L.A.
J. Sivewright, M.A., C.M.G.

FOR 1884—85.

Roland Trimen, F.R.S., F.L.S., F.Z.S., President.*
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F. Guthrie, LL.B.
P. MacOwan, B.A., F.L.S.
H. W. Oakley.
J. Sivewright, M.A., C.M.G.

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* The Rules of the Society provide that the President's Office cannot be held by the same person for more than Two Years consecutively.

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MINUTES OF PROCEEDINGS.

Ordinary Monthly Meeting.

WEDNESDAY, August 29, 1883.

MR. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

Donations were announced from Dr. Holub, the Ohio Institute of Mechanics, and from Sir H. E. B. Frere. The thanks of the Society were voted to the donors.

The President exhibited a specimen and enlarged drawing of the very remarkable *Acanthopterygian* fish, *Amphisile punctulata*, which had been sent to the South-African Museum by Colonel J. H. Bowker, F.Z.S., and was one of three specimens captured in the Bay of Port Natal. He called attention to the striking way in which everything about this animal appears to have been subordinated to the development of the solid dorsal bony sheath or cuirass, and cited Dr. Günther's account of the structure of the vertebral column, in correlation with this extraordinary plate armour, as "perhaps unique among the Acanthopterygians."

Messrs. Oakley, Young, and the Rev. G. H. R. Fisk asked some questions relating to the fish, to which Mr. Trimen replied.

Dr. Gill then gave an account of the longitude operations connecting Aden with the Cape. He described the methods employed in determining time, and exchanging signals, and the various precautions which had been taken to eliminate systematic error owing to variation of personal equation of the observers. This latter point he shewed was one of the greatest dangers, as regards accuracy, in operations like this. He also exhibited the Thomson Galvanometer used at Aden, and, as far as circumstances allowed, shewed the kind of signal received on it.

The thanks of the meeting were unanimously voted to Messrs. Trimen and Gill for their papers.

Ordinary Monthly Meeting.

WEDNESDAY, September 26, 1883.

Mr. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

The following gentlemen were elected Ordinary Members of the Society:—

Mr. Charles Molteno, Claremont.
,, Adam de Smidt, George.

Mr. G. Gresswell, B.A., Diocesan College, Rondebosch.
,, A. A. Bodkin, M.A., ,, ,,
Dr. C. K. Murray, Claremont.

and the following as corresponding members:—

Mr. R. Dowling, M.L.A., Aliwal North.
Mr. D. E. Hutchins, of the Indian Forest Service.

The thanks of the Society were voted to the donor (Dr. Von Hayek) of a series of the *Journal of the Ornithological Society of Vienna*, vols. 1—7.

The President then exhibited the mummy of a mouse which had been found in a box, containing red lead, at the Docks.

Dr. Gill exhibited a diagram shewing the recent tidal disturbances as recorded on the tide gauge at Port Elizabeth. He suggested that the disturbances were due to the recent volcanic eruption in Sunda Straits, and hoped that he would be able to lay more details before the Society at an early date.

In the discussion which ensued, the Hons. J. X. Merriman and C. A. Smith, and Messrs. Trimen, Guthrie, Young, Jenour (visitor), and Graham Bower (visitor), took part.

Mr. Gamble then read Mr. Emil Elmgren's paper "On the form of cross-section of a channel for constant velocity of water at different depths."

The Hon. C. A. Smith, Dr. Gill, Prof. Guthrie, and Mr. Young asked questions, to which Messrs. Gamble and Elmgren replied.

Mr. Gamble also described some peculiarities, designed by himself, in the construction of a siphon applied to the Berry Reservoir, Queen's Town.

He also described a very ingenious "siphon déversoir" designed for the silt-catching reservoir, St. Christophe, on the Marseilles Canal.

Ordinary Monthly Meeting.

WEDNESDAY, October 31, 1883.

PROF. GUTHRIE, LL.B., IN THE CHAIR.

Dr. Bisset Berry was elected an Ordinary Member of the Society.

Mr. Bolus read a note on the Orchids of the Cape Peninsula; prefacing it by an explanation of the various peculiarities to be found in these orders.

Prof. MacOwan testified to the great care and attention required for deducing such results as those obtained by Mr. Bolus.

Dr. Gill exhibited diagrams of the Tidal Disturbances at Cape Town, Port Elizabeth, and Port Alfred at the time of the recent disturbances in the Sunda Straits, and read an account of the phenomena observed at Mauritius about the same date. He found that sufficient data were not yet available for determining the origin of the disturbance.

An extract from a letter from a gentleman at Caledon was read, to the effect that a shower of sulphur had been observed there, and that the shower had been tested by a chemist.

Mr. T. Stewart believed that the source of disturbance was situated some distance from Java, giving reasons for his belief.

Ordinary Monthly Meeting.

WEDNESDAY, November 28, 1883.

HON. J. X. MERRIMAN, M.L.A., IN THE CHAIR.

Lieut. Graham Bower, R.N., was elected an Ordinary Member of the Society.

The Secretary read a letter from Mr. M. Kihn on the recent deposit of sulphur during a shower of rain at Caledon.

The Rev. G. H. R. Fisk, exhibited 7 specimens of snakes, and read a short paper in connection with them.

The Secretary then read a paper by Capt. Balfour on "Irrigation in the valleys of the Visch and Zak Rivers in the Calvinia and Frazerburg Districts." Having described the capacity of the country, drained by these rivers, for irrigation works, Capt. Balfour gave instances of its extraordinary fertility; the soil, when favoured with rain, yielding three harvests from a single sowing.

Mr. A. Auret (a visitor), corroborated this testimony to the natural richness of the soil in parts of Calvinia and Victoria West. He also related his experiences of the general value of irrigation—notably in the Oudtshoorn district.

Messrs. Goldschmidt (a visitor), Wiener, Bolus, and the Hon'bles Merriman and Smith also spoke on this interesting subject.

Before recording the thanks of the meeting to Capt. Balfour, the Hon. J. X. Merriman made some general remarks on irrigation, which he was pleased to notice was attracting more public interest than heretofore. The provisions of the Irrigation Act, he regretted, were not yet so well known as they should be by farmers. He then proceeded to explain some of the advantages of this Act.

A vote of thanks to Capt. Balfour closed the proceedings.

Ordinary Monthly Meeting.

WEDNESDAY, January 30, 1884.

MR. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

The following present was announced, and the thanks of the Society voted to the donor:—

Department of Mines, N.S. Wales,
Annual Report of the Dept. of Mines for 1882.

A letter was read from Dr. Holub, regretting his inability to attend this meeting.

Mr. H. W. Oakley then read his paper "On the Snake called the Mamba, of Natal."

The Rev. G. H. R. Fisk said that no snake of this species had been seen alive in Cape Town, and gave some particulars about snakes of a similar family in India.

Mr. Trimen said that he had seen a green Mamba in Natal, but had not been able to secure it: he noticed that one great peculiarity about this snake was its capability of rapid motion, this, with its great size, making it one of the most formidable reptiles in existence. He referred to the peculiar bony projection pointed out by Mr. Oakley, and thought that such projection might be traced through different specimens of the same class. He also made some very interesting remarks on the use of the fangs of snakes.

Mr. Bolus and Dr. Shaw gave some interesting remarks on the subject of snakes in general.

Mr. Rutherfoord stated that he had kept snakes in a box for twelve months without any food, but gave them water: they used the water also for washing. He found it difficult to get snakes in confinement, especially the smaller ones, to take food. He also described several experiences he had had with mole-snakes.

The Rev. G. H. R. Fisk stated that his boxes of snakes had been received at the Zoological Gardens. The larger ones arrived all well, but the smaller ones were dead.

The Secretary read a letter from Mr. Garwood Alston (Frazerburg district), describing some phenomena he had observed in connection with the evening glow, and he also read letters to the London *Times* by Messrs. Preece and Crookes on the same subject.

Ordinary Monthly Meeting.

WEDNESDAY, February 27, 1884.

Mr. J. G. GAMBLE, M.A., VICE-PRESIDENT, IN THE CHAIR.

Mr. Bolus exhibited a specimen of a species of *cineraria* recently found by him on Table Mountain and which he believed to be new; also a specimen of *vittaria lineata*, Sw. gathered in the same locality, and which had not before been reported from the Cape Peninsula.

Mr. Gamble exhibited a seed of *Martynia diandra*, from India, shewing the hooks adapted for the dissemination of the seed.

Professor MacOwan alluded to similar provisions upon other seeds of plants belonging to the same family.

Mr. Gamble then read a paper by Mr. Geo. McKay, of East London, "On the Geology of the Coast between the Fish and Juja Rivers in South Africa."

Prof. MacOwan exhibited specimens of *Spirogyra Sp.*, and explained the processes of reproduction of certain *Algae* by conjugation.

Ordinary Monthly Meeting.

WEDNESDAY, March 26, 1884.

MR. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

Mr. Victor Paré and Mr. Arthur Biden were duly elected Ordinary Members of the Society.

The following presents (books) were received and the thanks of the Society voted to the donors :—

Director of the Geological and Natural History Survey of Canada.

Report of Progress, 1880-'81-'82, with maps.

Catalogue of Canadian Plants, Part I., Polypetalse.

Dr. Ackermann, Cassel.

Bericht des Vereines für Naturkunde, zu Cassel, XXVIII.

Mr. Oakley exhibited a snake,—*homolosoma lutrix*, presented to the S. A. Museum by Mr. Hugo, of Simon's Town. It gave birth to sixteen young ones while in a state of captivity. The young ones were born alive. It was not previously known that this snake was viviparous.

The President announced the bestowal of the silver medal of the Zoological Society of London, on Mr. Fisk, for his different and varied contributions.

Mr. Stewart then read Mr. McKay's paper "On the Geology of the Coast between the Great Fish and Juja Rivers in South Africa."

Mr. Dunn testified to the value of Mr. McKay's work, but could not agree with some of the writer's statements, especially in the clap-conglomerate being an intrusive rock. The dykes, he said, did not lie, so far as he had seen, in parallel lines, but were to be found at various angles. He considered that the dykes were formed either during or at the close of a volcanic period.

Dr. Shaw said it appeared that we had three periods of volcanic outburst in the Colony, and agreed with Mr. Dunn in the upheaval of the dykes generally. He agreed also that the dykes were not parallel, but intersected at all angles. He also stated that the paper was incomplete in so far that it did not describe the various formations.

Both speakers testified to the value of Mr. McKay's paper as representing the result of actual observation.

Mr. Stewart replied that Mr. McKay had purposely left out sedimentary rocks, but meant to make them the subject of another paper.

The Secretary then read Mr. Andrew Smith's paper "On disturbances to Thermometers from local causes."

The discussion on this paper was postponed till the next meeting.

Ordinary Monthly Meeting.

WEDNESDAY, April 30, 1884.

MR. J. G. GAMBLE, M.A., VICE-PRESIDENT, IN THE CHAIR.

Donations were announced from Dr. Gill, Mr. Finlay, and the Smithsonian Institution, and the thanks of the Society were voted to thedonors.

The Secretary read portions of Mr. Andrew Smith's paper "On disturbances to Thermometers from local causes."

Mr. Gamble called attention to an extensive series of experiments that had been made in England as to the best form of thermometer crib; it was found that Stevenson's gave the best results. He also referred to a paper by Dr. Gill on "The effects of different exposures of thermometers in estimating the temperature of the air," and to one that he himself had already laid before the Society on "Summer and Winter Temperature in South Africa."

Mr. Bolus doubted the mean annual temperature being 6° lower at Lovedale than at East London as stated in Mr. Smith's paper.

The Hon. C. A. Smith remarked that it did not necessarily follow that the best form of crib for England is the best form for this country. It was shewn in the paper that in cloudy weather the results were satisfactory. He did not think that thermometers should be shut up so closely as indicated in the paper.

Mr. Bolus, in connection with the point of the variation of products owing to elevation, quoted some great differences between the ranges of plants as found here compared with others in Scotland. This variation was much less marked in South Africa than elsewhere. He considered that South African plants depend more on the hygrometrical condition of the atmosphere than on temperature.

Mr. Gamble said that on Table Mountain he had found the maximum 7° or 8° lower than at the Observatory, but the minimum only 2° or 3° lower. He pointed out that the L'Agulhas current might affect the minimum at East London.

Prof. MacOwan and Mr. Finlay also took part in the discussion.

The Secretary then read Dr. Musket's paper on the question, "Does the Moon influence the weather?" and Mr. Bolus read a further note from Dr. Musket.

The Hon. C. A. Smith could not agree with the paper. He referred to the inaccuracy, as a rule, of popular belief, and was unable to see how any action of the moon could depend upon its phases.

Mr. Finlay gave an account of an investigation into a very strong popular belief, made by Sir G. B. Airy in 1851, which was distinctly negatived by the results of seven years observations at Greenwich. The results of fifteen years hourly observations at Batavia did shew an aerial tide due to the moon, but it only amounted to 0·002 of an inch.

Mr. Silberbauer said that he had observed that clouds dispersed under the full moon.

Mr. Gamble quoted Laplace's result that the greatest possible aerial tide that could be raised by the moon was 0·007 of an inch. He said

that Mr. Glaisher had found some influence of the moon on rain-fall, and that Mr. Allan Broun considers that the moon has electrical influence.

Ordinary Monthly Meeting.

WEDNESDAY, May 28, 1834.

MR. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

It was reported that Dr. Holub had brought out a large number of valuable books, chiefly medical, which had been presented to the Society by certain Austrian firms.

The thanks of the Society were unanimously voted to Dr. Holub and the Austrian publishers.

The Rev. G. H. R. Fisk exhibited four tortoises from Namaqualand, and drew attention to their peculiarities. They differed considerably from others that had been exhibited before, especially about the beak and nuchal shield.

The President said that many specimens had been found in the N.W. parts of the Colony which were not common elsewhere. He offered to compare those exhibited with the specimens in the Museum.

The Rev. G. H. R. Fisk then read a portion of a letter received by him from the Prosector to the Zoological Society of London, regarding the alleged existence—in this Colony—of earthworms six feet in length.

Prof. Guthrie stated that he had seen—at Paarde Poort—earthworms four feet long.

Mr. Bolus had also seen a similar thing in 1874 at the same place—near Jansenville. The whole of the road for some distance was thinly covered with these worms. They were about five feet long.

Mr. Bolus suggested that application should be made to the medical officer at Jansenville to secure some of these worms.

Mr. Gamble then exhibited some diagrams shewing the average rainfall for each month for many stations in the Colony.

He pointed out that the chief inland rain fell in March. There was also a secondary maximum at Graham's Town and district in November.

Mr. Gamble also referred to Mr. Smith's statement about the mean temperature at East London and Lovedale, which he shewed to be incorrect.

He drew attention to the morning meteorological observations and their use.

He also gave results of maximum and minimum temperature on Table Mountain, and pointed out that the maximum on the mountain is always less than at the Observatory or Wynberg, while the minimum on the mountain is generally lower in summer but not in winter.

Mr. Bolus stated that in the Karoo, at Namaqualand, he found flora, which by their character seemed to belong to districts where the rains came at the end of summer.

The Rev. G. H. R. Fisk, Messrs. Finlay, Jackson, Schunke, Guthrie, and Bolus took part in the discussion.

Mr. Schunke had noticed that the rains in the Transkei were more equably distributed than in the Colony.

The meeting then adjourned with a vote of thanks to Mr. Gamble.

Ordinary Monthly Meeting.

WEDNESDAY, June 25, 1884.

Mr. J. G. GAMBLE, M.A., VICE-PRESIDENT, IN THE CHAIR.

The Chairman read portions of a letter from Dr. Holub, describing his observations made in the vicinity of Cape Town while awaiting funds from Austria to enable him to pass his goods through the Customs.

The Chairman exhibited the medal presented to the Rev. G. H. R. Fisk, by the Zoological Society for his various contributions of specimens.

Mr. Stewart exhibited some Geological specimens which formed portions of a considerable collection made by himself, and which he hopes to bring before the Society shortly.

The Rev. G. H. R. Fisk stated that the fern-like formation—*dendritic manganese*—had been found in the excavations at the docks.

Mr. Kearns had seen specimens of graphite, similar to that shewn, in considerable quantities in the Robertson district.

Mr. Gamble described some Barometric curves he had drawn. He stated that his remarks were given on account of many queries, "Why no inland stations were included in the 8 A.M. weather report?" The reason was because we do not know the reduction of barometer readings for high stations. He instanced observations on the Puy de Dôme and at Clermont at the base.

Mr. Dickson and Captain Warton (visitors), Mr. Silberbauer, Rev. G. H. R. Fisk and Mr. Finlay, asked questions, to which Mr. Gamble replied.

The Rev. G. H. R. Fisk exhibited three tortoises which had been sent to him from Port Elizabeth, and which were stated to be a variety of *chersina angulata*. He explained the difference of these from the ordinary specimens.

Annual General Meeting.

TUESDAY, July 22, 1884.

MR. R. TRIMEN, F.R.S., PRESIDENT, IN THE CHAIR.

The Secretary's and Treasurer's Reports for the year were read and adopted.

The Meeting then proceeded to the election of the President and Council for the ensuing year; Messrs. Biden and Silberbauer being elected scrutineers for the ballot.

Visitors having been admitted, the President introduced Mr. Bolus, who read the President's Address.

At the close of the Address a vote of thanks, proposed by the Hon. C. A. Smith and seconded by the Rev. G. H. R. Fisk, was carried unanimously.

The result of the ballot was as follows :—

President,—Mr. Roland Trimen, F.R.S., F.L.S., F.Z.S.

Members of Council,—Mr. H. Bolus, F.L.S.
Mr. W. H. Finlay, B.A., F.R.A.S.
Rev. G. H. R. Fisk, C.M.Z.S.
Mr. Gamble, M.A , M. Inst. C.E., F.R.M.S.
Mr. D. Gill, LL.D., F.R.S., F.R.A.S.
Prof. Guthrie, LL.B.
Prof. MacOwan, B.A.
Mr. H. W. Oakley.
Mr. J. Sivewright, M.A., C.M.G.
Hon. C. A. Smith, M.A.

REPORT ON THE PROCEEDINGS

OF THE SOUTH AFRICAN PHILOSOPHICAL SOCIETY

During the Year ending July 22nd, 1884.

1. Since the last Annual General Meeting ten Ordinary Monthly Meetings have been held. The average attendance of members at each meeting has been about twelve, and that of visitors about six, making the total average attendance of members and visitors about eighteen.

2. At the monthly meetings twenty-three papers have been read before the Society. Of these three related to Astronomy, four to Botany, two to Engineering, two to Geology, one to Mathematics, five to Meteorology, and six to Zoology.

3. Donations of books have been received from the Ohio Institute of Mechanics, the Department of Mines, New South Wales, the Smithsonian Institution, the Director of the Geological and Natural History Survey of Canada, Dr. Holub, Sir Bartle Frere, Dr. Von Hayck, Dr. Ackermann, Dr. Gill, and Mr. Finlay.

4. During the year nine ordinary and two corresponding members have been elected. The Society has lost one member by death, nine have resigned, and the names of two other members have been removed from the list for non-payment of their annual subscriptions in accordance with Section I. No. 4 of the Society's Bye-Laws. The total number of ordinary members is seventy-five.

5. Vol. III. of the Society's Transactions has been issued to members.

6. The thanks of the Society are due to the University Council for granting the free use of its rooms for the Society's meetings. Arrangements have now been made for the use of the Side-room at the Commercial Exchange for the ordinary meetings.

7. The Council has to announce that the Government has withdrawn the privilege, allowed to the Society since its foundation, of free postage on correspondence franked by the Society's officers. It is hoped, however, that the privilege will be restored.

8. A very valuable series of paintings of Cape orchids has been prepared by Mr. Bolus, and will be published by the Society if possible. Authority has already been given for ten of these plates to be printed.

W. H. FINLAY, Gen. Sec.

Dr. The Treasurer in Account with the [illegible]

1883.		£	s.	d.	£	s.	d.	1883.		£	s.	d.	£	s.	d.
July 1	To Balance—								By Advertising and Stationery..		..		28	5	6
	Fixed Deposit	200	0	0					,, Hire of Rooms and Expenses connected with Lectures ..		..		24	17	6
	in Standard Bank (less cheques outstanding)	76	8	4					,, Printing Transactions ..	92	17	7			
	Petty Cash	1	19	8					,, Advance for Printing Plates of Orchids (H. Bolus)	30	0	0			
					278	8	0		,, Correcting Catalogue	2	8	3			
	,, Subscriptions	140	0	0									125	5	10
	,, Overpayments on same	0	7	0					,, Clerical Assistance to Secretary and Treasurer		..		31	0	0
					140	7	0		,, Fees to Collectors of Subscriptions		..		5	18	0
	,, Interest on Deposit, at 6 p.c. (to 4/2/83) ..	12	0	0					,, Petty Expenses—						
	,, Do., do. (to 20/4/84)	14	9	3					Postage, Railway Fares, &c.	2	15	5			
					26	9	3		Commission charged by Standard Bank	0	10	6			
	,, Sale of Transactions..		..		0	15	0		Petties, as per Voucher marked No. 52..	1	19	8			
									Carriage on Books	0	5	0			
													5	10	7
									,, Rent, Mutual Buildings ..		..		12	0	0
													232	17	5
									,, Balance { Mortgage Bond..	200	0	0			
									,, Balance { Bank Balance ..	13	1	10			
													213	1	10
					445	19	3						445	19	3

Cape Town, 21st July, 1884.

C. ABERCROMBIE SMITH, Hon. Treasurer.

ANNUAL ADDRESS TO THE MEMBERS OF THE SOUTH-AFRICAN PHILOSOPHICAL SOCIETY.

On Tuesday, July 22, 1884,

By the President, Roland Trimen, F.R.S., F.L.S., F.Z.S.

PROTECTIVE RESEMBLANCES AND "MIMICRY" IN ANIMALS.

There are few, if any, among the manifold aspects presented by Zoology more attractive and fascinating to the observer than that of the adaptation of different forms of animals to their respective environments or conditions of life. And in this particular field *of* observation perhaps few points exceed in interest the extraordinary *disguises* which the exigencies of existences render necessary to the possessors if they are to hold their own in the battle for life.

My own studies having partly lain in this direction, I have thought that some remarks on the subject, illustrated more especially *from* South-African material, might prove not unsuitable as the theme of my Address at our annual meeting.

It is hardly necessary to point out how largely this and kindred inquiries have gained in value and interest since the progress of Science has made it clear that the great drama of organic life is not, as once it was assumed to be, one set scene in which the same actors for ever performed the same unchanging parts, but rather a wonderful series of exquisitely graduated changes, ever leading on to new developments. Life hardly seemed alive when the hard and fast immutability of all its countless forms was the accepted doctrine—it was a mechanism always working with identical results. But, once regarded as "the long result of time," and acknowledged as the multiform development of few and simple early elements, organic Nature acquires a far intenser vitality, and is possessed of the added charms of a history and of a future.

And this more vivid and vital character is impressed not only on the world of animals and plants generally, but on every class and order of living beings down to the species and the individual itself, because we recognise in them all the interest attaching to that struggle for existence in which man himself has to take part.

What this struggle really amounts to was for the first time fully grasped and elucidated by the illustrious Darwin, in the third chapter of his "Origin of Species." He conclusively shows that the high rate of multiplication of all organic beings—even of those which increase most slowly—necessitates the keenest conceivable competition

for the limited food supply, and for the very standing-room available. As is well known to all, it is on this indisputable state of things that he bases his main argument of "Natural Selection," or the "Preservation of Favoured Races in the Struggle for Life," inevitably resulting from the perpetual elimination of all individuals less able than others to grapple with their surrounding circumstances, and the consequent "survival of the fittest" only.

Professor Candèze has well observed that the main endeavour of every living being in nature is twofold, viz., on the one hand, to get enough to eat; and, on the other, to escape being eaten. To ensure this double object the most strenuous efforts are made; and it is obvious that, in such a competition for the means of existence, the slightest superiority or advantage must tell in favour of its possessor. Upon a very little difference in strength, swiftness, tenacity, weapons, acuteness of perception, or intelligence, the issue of life or death will depend, where there is enough for one but not for two, or when it is a question of hairbreadth escape from a devouring foe.

It is with regard to these all-important matters of obtaining a sufficiency of food, and escaping being fed upon, that the advantages of disguise and concealment become manifest, If the desert lion finds the advantage which his tawny hair gives him in stealing unobserved upon his prey, none the less does the desert antelope owe his safety to the isabelline colour of his coat. Nothing more strikingly illustrates the uses of concealment than the fact that in the wide unsheltered spaces where there is no cover of any description, all forms of animal life partake of the prevalent colour of the surface,—isabelline on the desert sands, pure white on the arctic snows.

Mr. A. R. Wallace, who has devoted great attention to this subject and published some excellent papers dealing with it, points out how very generally dwellers among leaves or grass are green; instancing the parrots and green fruit-pigeons among birds, the iguanas and tree snakes among reptiles, and the tree-frogs among amphibians, as prominent cases of the kind. Among insects numbers of species haunting herbage and foliage are green, notably in such familiar groups as grasshoppers and caterpillars.

From such general adaptation to surroundings as those just referred to, we may pass to that of a more specialized kind, which prevails very largely throughout nature, embracing innumerable cases of more or less exact resemblance in colouring and in surface to inanimate or to vegetable objects. Peculiarities of the soil; of rocks and stones on its surface; of the bark of trees and shrubs; of mosses, lichens, and algæ; of leaves, flowers and stems;—are everywhere reproduced in the aspect of the animals respectively frequenting those objects. It is when absorbed in seeking or taking food, or when sleeping, that most creatures are specially exposed to danger, and it is manifest what protection must be afforded them by more or less similarity to the things about them.

Our observant colleague, Mrs. F. W. Barber, has recorded numerous interesting cases of this kind that have come under her personal notice, in her paper on the "Peculiar Colours of Animals in relation

to their Habits of Life" pbblished in Part 2 of the 1st Volume of the Society's 'Transactions.' She has carefully noted how the colouring of certain South-African sun-birds accords with those of the flowering aloes and *Erythrina* trees which they frequent; and how the beautiful Fruit-Pigeon (*Treron Delalandii*) is scarcely distinguishable among the fruit and foliage of the wild fig, while the richly-coloured "Lory" (*Turacus albo-cristatus*) as closely resembles those of its favourite wild vine. Still more striking are the cases which Mrs. Barber describes of the large Chamæleon inhabiting the Acacias of Griqualand West, which changes its tint of green according to the seasonal changes in the foliage of its home; of the *Zonurus* lizard of the same country, whose hues temporarily agree with those of the brilliant species of *Mesembryanthemum* among which it hunts the butterflies; and of the little Tree-Frog (*Hyperolius*) whose lovely colours similarly but even more rapidly are altered totally by its transfer from flower to flower of different hues. In this case and in those of the Chamæleon and *Zonurus*, the double object is promoted of "getting enough to eat and escaping being eaten; all three animals being insectivorous, but at the same time themselves liable to become the prey of snakes and rapacious birds. This power of adapting the external colouring according to the occasion is a very distinct advance on possessing but one fixed protective hue, and must afford its fortunate owner a much wider and safer range of action.

An extremely remarkable case among the class of Fishes, which has been cited by Mr. Wallace, is that of *Phyllopteryx*, an Australian genus closely allied to the well-known "Sea Horse" (*Hippocampus*) of the South-African and other coasts. All the members of this curious group (the *Hippocampina*) are small weak fishes of very limited powers of locomotion, but are invested with an armour of bony plates. By means of their slender prehensile tail (which is without any fin) they attach themselves to seaweeds, and so are less at the mercy of the current. In *Phyllopteryx* the head and body generally are set with spines or processes, and from the tips of many of these spines proceed long strips or filaments, which in colour and form are exceedingly like the seaweeds which these fishes frequent. As the colour of the whole animal is the same, it may be readily imagined how thoroughly these extraordinary appendages serve to conceal the fish.

The instances noticed are but samples of the large number known amongst vertebrate animals; and when we proceed to review the vast class of Insects and their allies, so numerous are the cases in point that the difficulty is which to select as illustrations. The colour of the bare ground is reproduced in many beetles—in South Africa notably by Curculionidæ and Heteromera,—and in a multitude of grasshoppers and locusts. Some of the latter groups are exactly of the tint of the ground they haunt, so that it is next to impossible to see them as long as they remain motionless. The most specialized case among those known to me of this kind is that of the wingless Acridian genus *Batrachotetrix*, which has more than one representative in South Africa. The best known species, *B. bufo*, has been dubbed the "Stone Grasshopper" by Mrs. Barber, and well deserves the title; for in colouring,

granulation of surface, and the singular flatness of the back, it precisely resembles the small stones which lie about on the surface of the ground which it frequents. In a locality near Graham's Town, where this species was numerous, Mrs. Barber and myself found it most difficult to detect the insect, as it was remarkably sluggish, and hopped but feebly and reluctantly even when we literally kicked it up. A circumstance most worthy of note is that the colouring of this curious grasshopper copies that of the particular little group of stones among which it lives; and I found this to be the case in quite a limited extent of ground, a set of mottled stones occupying a small space having among them *Batrachotetrix* of corresponding tints, while but a little way off a set of uniformly dark or light stones harboured grasshoppers of like hues.

Several South-African butterflies are protected at rest by the similarity of the under-surface of their wings to the ground on which they settle. The beautiful *Junonia Cebrene* and *J. Clelia* are thus often rendered almost invisible; and as the former species has been observed by Colonel Bowker to be much hunted by lizards, no doubt the resemblance is of considerable service to them. The same kind of protective colouring is shown by many of the small butterflies belonging to the genus *Zeritis*—a very characteristic Cape group.

The bark of trees and the lichens which cling to it find innumerable faithful copyists among insects, whole groups of beetles and moths more or less exactly reproducing each rugosity and tint of their wonted resting-place. The most practised collector will frequently fail to distinguished the best disguised of these insects, which to ordinary eyes are practically invisible.

Mr. Wallace records his obtaining in Borneo one of the "Spectres" or "Walkingstick Insects" (of the orthopterous order), which was covered with foliaceous excrescences of a clear olive-green colour, so as exactly to resemble a stick grown over by a creeping moss of *Jungermannia*. Quite as marvellous an imitation is the widely-known one of the "Leaf Insects" *par excellence*, a genus of the same family, many species of which occur in the islands of the Malayan Archipelago; and it is difficult to believe without close inspection that these species of *Phyllium* are not in reality the leaves of the plants on which they live. In the Karroo districts of this colony there occurs not uncommonly a very fine Walking-Stick Phasma (*Palophus Haworthii*), attaining a length of seven or eight inches, which in its quiescent condition precisely simulates the dried-up rough greyish-brown twigs of the dwarf shrubby plants characteristic of the country.

The whole order of the Orthoptera is remarkable for the likeness to vegetation which very many of its members present, even the predaceous *Mantidæ*, or "Hottentot Gods," affording numerous examples, some of which are very striking. One Natalian species, *Phyllocrania paradoxa*, is almost as close an imitation of dead leaves as *Phyllium* is of living ones; while the young of *Harpax ocellata*, sent me alive from D'Urban by Col. Bowker, have an extraordinary resemblance to a purple flower of the composite type. In this latter instance the resemblance is brought about by the position of the flat round abdomen,

which is turned upward and backward over the hind and middle parts of the thorax, so that its lower surface, set with a central row and double lateral rows of purple foliaceous expansions, is fully exposed. This case of *Harpax* resembles that mentioned by Mr. Wallace, of a Javanese Mantis which exactly resembled the pink flower of an orchid,

We can readily perceive the advantage of this harmless plant-like appearance to such voracious devourers of other insects as the Mantidæ, whose habit it is to remain motionless among vegetation nntil seme unwary prey comes within reach of their long spiny arms.

As already mentioned, the unarmed race of butterflies and moths depends largely upon protective colouring, which, in accordance with the different posture of the wings in repose, is disposed in the former on the under-surface of the hindwings and of such part of the forewings as is exposed, while in the latter it characterizes the upper-surface either of all the wings or of the forewings only. In South Africa I have noticed various butterflies possessed of this kind of protection in a high degree; such as, for instance, *Melanitis Leda*, which rests among dead leaves on the ground in shady places, and is then indistinguishable from them; and the female *Eronia Leda*, which settles on the faded bright-yellow leaves of the Erythrina tree. Mrs. Barber noticed, near Grahamstown, quite similar behaviour in the conspicuous male *Papilio Cenea* (*Merope* auct.), which twice deliberately selected in her garden, as a resting-place during a shower of rain, a shrub whose yellow and brown seeds and flowers entirely resembled the colouring of the underside of his wings.

But by far the most elaborate imitation of this kind among butterflies is the famous one, so well explained by Mr. Wallace, of the Indian and Malayan *Kallima Inachis* and *K. Paralekta*. In these species, which on the upperside are deep-blue and orange, the underside copies with perfect accuracy the withered or shrivelled leaves of dead trees or bushes, the imitation going into such details as to reproduce in appearance even the minute fungi or moulds that grow on the leaves! But this is by no means all the extent of the mimicry; the shape of the wings when the insect is at rest exactly representing both the pointed apex and the foot-stalk of the leaf, and the attitude assumed both bringing into prominence these details and concealing such parts as the head and antennæ which might impair the completeness of the deception. To give an idea of the exactness of the imitation, I may mention that Mr. Wallace had a case (which he shewed to me) containing one of these butterflies with expanded wings and a number of other specimens at rest in their natural attitude on a branch. When this case was exhibited to anybody not specially aquainted with such matters, it was his wont to ask how many butterflies were in it, and the answer would always be "One"—meaning the conspicuous blue-and-orange individual with outspread wings. Mr. Wallace would then explain the imitation, showing that the apparent leaves on the branch were actually butterflies. But he had cunningly left one real leaf among them, and when, after explanation, he would say, "How many butterflies do you count now?" I believe

that almost invariably the answer gave *one too many*, because the real leaf was counted by the spectator as one of the butterflies!

The numerous disguises assumed by Spiders have formed the subject of a special paper by Prof. Pavesi (Atti d. Societa Ital. d. Scienze Naturali, vol. xviii., 1875), and among them some of the most interesting are those presented by hunting or wandering spiders, which do not construct webs for netting prey but trust to their activity or patience. Many species of *Thomisus* are well adapted to succeed by being coloured in resemblance to the flowers in or on which they await the arrival of their victims. One that inhabits Cape Town is of the exact rose-red of the flowers of the Oleander; and, the more effectually to conceal it, the palpi, top of cephalothorax, and four lateral stripes on the abdomen are white, according remarkably with the irregular white markings so frequent on the Petals of *Nerium*.

I was led to notice a yellow spider of the same group, in consequence of seeing that two of a number of butterflies on the flowers of *Senecio pubigera* did not on my approach fly off with their companions. Each of these unfortunates turned out to be in the clutches of a spider, and when I released them, I observed their captors very narrowly, and found that the latter's close resemblance to the *Senecio* flowers was not one of colour alone, but due also to attitude. This spider, holding on to the flower-stalk by the two hinder pairs of legs extended the two long front pairs upward and laterally. In this position, it was scarcely possible to believe that it was not a flower seen in profile, the rounded abdomen representing the central mass of florets, and the extended legs the ray-florets; while, to complete the illusion, the femora of the front pair of legs, appressed to the thorax, have each a longtitudinal red stripe which represents the ferruginous stripe on the sepals of the flower.

On another occasion I witnessed the actual capture of a small blue butterfly (*Lycænesthes*) by a white spider of the same genus. The butterfly was engaged in honey-sucking on a white flower-head of *Lantana*, and explored each individual flower with its proboscis. While I was watching it, the butterfly touched and partly walked over what looked like a slightly faded or crumpled flower about the middle of the cluster. This turned out to be a spider, which instantly seized the butterfly, throwing forward its front legs somewhat after the fashion of a Mantis. In this spider, the effect of the little depressions on the limb of the corolla was given by some depressed lines on the back of its smooth white abdomen.

I have given above various of the more noteworthy instances of protective resemblance to (firstly) the prevalent general colour of the surroundings; and (secondly) the colour, form, &c., of particular objects mineral and vegetable. There remains for brief consideration a third and most interesting group of these resemblances, viz.: the cases in which other animals are imitated.

It is to this class of imitations that the term "mimicry" was the first applied by Mr. H. W. Bates; and, although the word has the defect of implying in ordinary usage *conscious or voluntary* imitation, it has been generally adopted, in default of any better one, to express

the actually deceptive likeness of one animal to another which in all essentials of structure is quite different.

These mimicries necessarily are of a more limited and special kind than those already treated of, seeing that the only animals to imitate which would be of advantage to others are such as can successfully resist their enemies, or are for some other cause exempt from persecution to a large extent, or can serve as prey if approached under cover of a likeness to themselves. If an unarmed creature can wear the aspect of one widely dreaded for its weapons of offence, or a soft and defenceless animal look as if it were encased in the armour of proof borne by some well-protected neighbour, or some toothsome and eatable being bear to deception the likeness of a malodorous, distasteful, uneatable one,—it is plain how useful the disguise would prove. And this is exactly what takes place in nature,—disguise is resorted to by those who lack the armour, or the weapons, or the uneatableness of the more favoured kinds.

But few cases of actual "mimicry" in this restricted sense have been recorded among the vertebrate animals, Mr. Wallace citing only a few cases where harmless Snakes (in Tropical America) copy in a very striking manner certain venomous kinds, and a group of Orioles (in the Malayan Archipelago) unmistakeably imitate the strong and active honey-suckers of the genus *Tropidorhynchus*. But amongst insects, the number of such cases is very large, and the record of them is constantly increasing, as the life-history and habits of the lower animals are more closely observed.

Taking first the case of the mimicking of well-armed by unarmed insects, we find that bees and wasps have exeellent imitators in the shape of many moths and two-winged flies, of some beetles, and of a few crickets; and that ants have also beetle mimickers. The transparent-winged moths of the groups represented by the genera *Sesia*, *Ægeria*, etc., and many species of *Glaucopidæ*, imitate so precisely the aspect of various stinging Hymenoptera that no one but an entomologist could distinguish them as Lepidoptera. One of these Ægeriid moths *Melittia ursipes*, is not uncommon in Natal; its general aspect and colouring and densely hairy hind legs make it exactly like a small bee. Most people must have noticed the drone flies (*Eristalis*) which haunt flowers, and not only look like bees, but get up a very fair imitation of an angry buzz, and even affect to possess a sting, when you hold them captive, by curving round the hind body. South Africa abounds in beautiful bee-like flies of the *Bombylius* type; and it is probable that, as has been shown in Europe and elsewhere, the disguise of these flies (which are in many cases parasitic as larvæ upon bees), enables them to enter, unsuspected and unharmed, the bees' nests, and there to lay their eggs. The beetles that find their advantage in resembling bees and wasps are chiefly members of the great wood-eating tribe of Longicorns, and in several cases their elytra are so much reduced as to leave nearly all of the folded wing-surface visible, an arrangement which greatly aids in the deception. Mr. Bates has recorded the wonderful resemblance which the crickets of the genus *Scaphura* in South America bear to different large sand-

wasps which are constantly searching for crickets to provision their nests with!

A very remarkable case of the mimicry of a predaceous beetle by a cricket (in the Philippine Islands), is given by Professor Westwood, in which the resemblance is so exact that even that most experienced entomologist was deceived, and placed the cricket among the specimens of the tiger-beetle in question in his collection!

It is among the Weevils or "Snout-Beetles" (*Curculionidæ*), and the allied *Anthribidæ*, that the best instances of defensive armour occur, many of these insects having such exceedingly hard integuments that no pin will pierce them. Mr. Bates records two, and Mr. Wallace five cases in which beetles of the Longicorn group closely copy *Curculionidæ* inhabiting the same districts; and in one of these Mr. Bates found the hard weevil and the mimicking Long-horn on the same tree.

Turning now to those cases where it is to the interest of defenceless forms which are palatable to their enemies to resemble creatures that are habitually rejected or passed by as uneatable owing to their offensive odour or taste, we find some of the most prominent and perfect mimicries known. The phenomenon is most complete and conspicuous among butterflies; and it is to the distinguished traveller and naturalist, Mr. Henry Walter Bates, F.R.S., that Science owes the first and only rational exposition and explanation of the subject that has been given. His memoir, read to the Linnean Society of London, in 1861, and subsequently published in the "Transactions" (Vol. xxiii.) of that body, was entitled "Contributions to an insect Fauna of the Amazon Valley. Lepidoptera: Heliconidæ;" and in it he lucidly presented the results of many years' daily experience and observation of the variation, habits, distribution, and relative numbers of the brilliant slow-flying species free from persecution, and of the accompanying imitative forms of different groups. Mr. Bates showed that, while the models were most abundant, and presented the ordinary facies of their family, the mimickers were rare, and departed very widely from the appearance of their nearest allies; that the latter frequented the same spots as their models, often flying among them; and that the resemblance in nature was so exact, that his own well-practised sight did not prevent his being constantly deceived by it when out collecting. He observed that the conspicuous and slow flying *Heliconidæ* were not pursued by any of the ordinary enemies of insects to which they would have fallen easy prey, and suggested the reason for this security in the peculiar smell which they emitted. Demonstrating the identity in kind of these most striking mimicries with the protective resemblances to vegetable and inorganic forms so widely prevalent in nature, he traced them all to the operation of "natural selection," the agents being none other than "insectivorous animals," which gradually destroy all the individuals of mimicking species least resembling those which are exempt from persecution.

Mr. Bates gives a list of no fewer than thirty-six cases of mimicry known to occur among the butterflies and moths of Tropical America. In one of these six species (three butterflies belonging to two families

and three moths belonging to two families) imitate one and the same Heliconide species, viz., *Methona Psidii*; and in another, four butterflies (of three different families) and a moth all copy *Ithomia Flora*. The imitations of species of *Ithomia*, *Mechanitis*, and *Methona*, Heliconide genera, by species of *Leptalis*, a genus of Pierinæ, or "White" butterflies, are so surprisingly perfect that nobody who has seen the insects concerned, or even the figures of them illustrating Mr. Bates' paper, can wonder at their deceiving on the wing the most experienced collector.

The view propounded by Mr. Bates received most weighty confirmation at the hands of Mr. A. R. Wallace, who, in his interesting paper on the *Papilionidæ* of the Mayalan Region (read to the Linnean Society in 1864), called attention to the occurrence of a quite similar series of mimicries in India and the Eastern Archipelago, and unreservedly expressed his entire concurrence in the explanation given of the causes at work in the production of them. Mr. Wallace pointed out that, as in America, so in the Old World, it is butterflies of the Danaid group that are most often the objects of imitation by those of other families, and gave a list of fifteen of the best-marked cases known among the *Papilionidæ* alone. The first of these may be noted as peculiarly interesting, seeing that the male and female of the mimickers, *Papilio paradoxa*, differ considerably, and that each mimicks the corresponding sex of *Euplæa Midamus*. In seven of the fifteen cases given only the female is mimetic, and Mr. Wallace suggested that the reason of this is probably that the slower flight of that sex when laden with eggs, and her exposure to attack while ovipositing, render it especially necessary to have a protecting disguise.

It was my good fortune to be able to supplement the cases brought forward by these distinguished explorers of South America and the Malayan Archipelago, by a similar series of mimetic analogies among African butterflies. From the beginning of my collecting in South Africa, I had been familiar with one or two striking instances of mimicry, and a visit to Natal in 1867 made me acquainted with several others. While in England shortly afterwards, I had excellent opportunities of working up the subject, and early in 1868 I read to the Linnean Society a paper (subsequently published in the 26th Volume of its "Transactions"), describing in detail the eleven cases of mimicry then known to me. It was interesting to be in a position to fortify the conclusions of Messieurs Bates and Wallace by personal observations made in an entirely different region. I showed how the *Danainæ* and *Acræinæ* of Africa, like their allies elsewhere were provided with offensive odours and secretions, and that several of them were accompanied throughout their geographical range by faithful imitators belonging to quite distinct groups. It was further pointed out (1) that the mimicking butterflies invariably occurred in districts inhabited by the species mimicked, and in six cases (South African) are found in the very same localities; (2), that in eight cases the mimickers are known to be very much scarcer than the species which they copy; (3), that in five cases where the *Danais* or *Acræa* presents local forms, or merely slight varieties, even these are

mimicked by individuals of the imitating species; (4), that in three cases, where the sexes of the insect mimicked differ remarkably from each other, the sexes of the mimicker present corresponding differences; and (5) that, in four cases observed by me in nature, it was next to impossible to distinguish the living mimicker from the species which it imitated. It must be remembered that these extraordinary likenesses are not those of general colouring and pattern alone, but include outline and form, extending to minute reproduction of prominent markings however small; and that the deception is often further borne out by following closely the kind of flight and mode of resting exhibited by the species copied.

Probably *Amauris Echeria*, a Danaide of wide occurrence in wooded localities, is the best-protected butterfly in South Africa, judging from the number of imitators to whom it seems to set the fashion. The most accurate copyist is the female *Papilio Cenea* (type), but the female *P. Echerioïdes* is almost as good,—while the males of these species of Papilio are utterly dissimilar both from their respective mates and from each other. Both sexes of *P. Brasidas* present individuals which fairly imitate *Echeria*; while among the *Nymphalinæ*, an almost exact reproduction occurs in both sexes of *Euralia mima*, and an approximate one in the female of *Pseudacræa Tarquinia*.

As the case of *Papilio Cenea* presents perhaps the most remarkable mimetic analogy yet recorded among butterflies, and as it has been worked out in South Africa, and is now widely known and quoted, it may be of interest to offer a few remarks upon it. The male of this species is a very fine conspicuous insect, with a peculiar colouring of very pale creamy-yellow, with a broad black border to the forewings and a black band across the disc of the hindwings,—the latter wings bearing each a long broad process or "tail." It is the Southern representative of the West-African *Papilio Merope*, and was formerly known under that name. Five-and-twenty years ago, nobody thought of associating with this beautiful butterfly the altogether different *Papilio Cenea*, which is black with ochre-yellow patches and spots, and has no tails on the hindwings, and—as mentioned above—is so close a mimicker of *Amauris Echeria*. Yet these strikingly dissimilar insects, when closely examined, exhibited so many points in common, that, finding only males of one pattern and only females of the other, and knowing that the two haunted the same woods, and that the conspicuous *Merope* had been seen in pursuit of the sombre-tinted *Cenea*, I was fully persuaded by the year 1867, that the two were sexes of one and the same kind. More than this, I felt next to certain that two other female Papilios, *P. Trophonius* and *P. Hippocoon*, var., one of which mimicks *Danais Chrysippus* and the other *Amauris dominicanus*, were also females of the same pale-yellow tailed male. In the paper dealing with mimetic analogies which I have already mentioned, I, in 1868, explained at some length, the grounds upon which my view of the case was founded; and, although few naturalists were then disposed to accept it, the truth of what was then advanced as in the highest degree probable has since been incontestably demonstrated by the observations of Mr. Mansel Weale who, in 1873, reared all the

four forms from eggs laid on the white ironwood (*Vepris lanceolata*) by a specimen of *P. Cenea*. Mr. Weale's researches and their result have recently been confirmed by Colonel Bowker's notes on the sexes in Natal.

We have thus the remarkable case of a butterfly, in which the male is of a certain conspicuous and unusual coloration which varies but little, while the female is of three quite different forms, each of which is entirely unlike the male, but imitates one of the three prevalent species of *Danainæ* inhabiting South Africa! It should be added that numerous intermediate variations of the females exist, which exhibit a series of links between the three prominent forms, and serve to indicate how plastic for further development in any advantageous direction the polymorphic female *Cenea* remains.

Other circumstances which add to the great interest of the case are 1. that the very closely allied true *Papilio Merope* of Western Africa also has a polymorphic female, several forms of which have been described as distinct species, and are found imitative of *Danainæ* inhabiting the same region; and 2. that in Madagascar the likewise closely-related *Papilio Meriones* has but one form of female, and that form slightly differing from the male! What is even more surprising is the fact, communicated to me by Mr. Ch. Oberthür in 1882, that the representative of *Papilio Merope* at Lake Tsana in Abyssinia also has the sexes almost exactly alike. The inference is obvious that the females in Madagascar and Abyssinia for some reason do not stand in need of the protective disguises so elaborately worked out for them in Southern and Western Africa. Probably some active persecutors of this large pale type of *Papilio* are absent in those countries, or may there have found some easier or more attractive insect prey. In South Africa the handsome Flycatcher, *Tchitrea cristata*, has been seen by Mr. Weale to capture the male *P. Cenea*, and he had reason to suspect a bird of an allied family and quite similar habits, *Dicrurus musicus*, to be another of this butterfly's enemies. Insectivorous birds of both these genera are found in Abyssinia—the very same species of *Dicrurus* is, I believe, a native of that country—and also in Madagascar; but it is possible that circumstances may have led to their leaving *Papilio Merope* and *P. Meriones* unmolested.

We have seen that there are certain cases in which insects escape by simulating the aspect of the very enemies that persecute their tribe, as, for instance, the *Scaphuræ* of South America imitate the Sand-Wasps which provision their nests with crickets; but there is a kindred class of mimicries, not very common, in which the advantage is reversed, the rapacious enemy, like the wolf in sheep's clothing, wearing the appearance of the creatures on which it preys. The *Mantis* family present some good cases of this description, Mr. Bates recording one occurring on the Amazon River, in which a Mantis exactly resembled the "White Ants" (*Termes sp.*), on which it fed. I suspect that a very slender, pale Mantis, which I met with in Natal, and which very closely imitated the appearance of certain *Phasmidæ*, was probably so disguised to enable it to prey more easily on the weak *Bacilli* of the same district. In this Mantis the rapacious fore-

paws were so formed and held as to hide their real character, and I took it for a *Bacillus* on first seeing it. Hunting Spiders are in some cases very like their prey, as may everywhere be noticed in the case of the species of *Salticus*, which catch house-flies on sunny walls and fences. The likeness is not in itself more than a general one of size, form, and colouring; but its effect is greatly aided by the actions of the spider, which walks hurriedly for short distances, stopping abruptly, and rapidly moving its falces, in evident mimicry of the well known movements so characteristic of flies. Many spiders exhibit a strong resemblance to ants, and Mr. Wallace states that those of one tropical genus which feed on ants are exactly like their prey.

Having now rapidly glanced at some of the more prominent instances of the various descriptions of protective resemblance existing in nature, it only remains for me to repeat my conviction that upon the theory of "natural selection" alone are they at all explicable. If we assume the independent creation of all species of organic beings precisely as we now behold them, it is impossible to understand why there should have been this system of disguises at all. If from the very first the destined prey of other animals possessed in every case the appearance we now find them possessing, would the resemblances we have been considering have protected them in the least? Can it be supposed that certain species of butterflies were created in great abundance, and that certain other species of widely different structure, but superficially imitating the former, were simultaneously created in very small numbers, in order to maintain a precarious existence for ever afterwards? What is the meaning, on this view, of all the gradations in protective resemblance, the incompleteness or imperfection of some mimicries? To these and many other questions that readily occur to us, no satisfactory reply can be made, if it be insisted on that species are immutable, and that the organic world is now in all respects exactly the same as when it sprang into being. But these problems become intelligible when viewed as the natural consequences of the innate variability of species, and the preservation and development by inheritance, through all time and under all changes in surrounding conditions, of every successive variation advantageous to the organism originating it.

In conclusion, let me express the hope that those who reside in South Africa, and are interested in natural history—especially such of them as belong to the Society—will not be content with merely collecting specimens, but also study the habits and ways of life of the creatures in their natural haunts. This part of the world is rich in the variety of organic forms peculiar to or characteristic of it, and it cannot be doubted that very many instances of such adaptations as those we have been considering await discovery in the remoter districts and even in those which have been most explored. It is impossible, without patient study and observation of an animal among its normal surroundings, to understand the meaning of numerous details in its aspect and structure,—particularly as regards its movements and its attitudes in action or in repose. As all naturalists are aware, there

are innumerable instances in which animals removed from their wonted environment are most conspicuous, and appear as if nothing could conceal them, and yet in their natural haunts are so well adapted to the objects about them as to be only discoverable by most careful search. There is no need for me to descant upon the pure and varied pleasures which attend the pursuit of natural history—everybody who has ever entered upon it has experienced them in some degree, has felt the zeal of the explorer and the delight of the discoverer,—but I wish to suggest what a rich and deeply-interesting field of research lies open to us in this country in the detection and illustration of new instances of protective resemblances and mimicries in the South-African fauna.

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THE TRANSACTIONS

OF THE

South-African Philosophical Society.

XV.—NOTE ON A SPECIMEN OF *AMPHISILE PUNCTULATA*, BIANCONI, FROM PORT NATAL.

By Roland Trimen, F.R.S., &c., President S.-A. Philosophical Society.

[Read 1883, August 29.]

Three examples of the very remarkable fish which I have now the pleasure of exhibiting were lately captured in the Bay of Port Natal, and the specimen before the meeting is one of them, and was secured for the South-African Museum by Colonel J. H. Bowker, F.Z.S., one of our Corresponding Members.

The genus *Amphisile* contains three known living species, whose range extends throughout the tropical Indian Ocean and as far as China. Remains of an extinct congener are recorded from Eocene strata at Monte Bolca near Verona. Together with the well-known Trumpet or Bellows Fishes (*Centriscus*), the genus constitutes the family *Centriscidæ*, placed by Dr. Günther ("*Study of Fishes*," p 510, 1880) in the 13th Division of the Acanthopterygii, next to the division containing the Sticklebacks (*Gastrosteidæ*) and the Flute-mouths (*Fistulariidæ*).

The most striking feature in *Amphisile* is that all the dorsal region of its laterally strongly compressed and very thin body is completely enclosed in a rigid sheath of bony plates. Dr. Günther, who has published ("Catalogue of Fishes in the Collection of the British Museum," vol. iii, p. 526; 1861) a detailed description of this structure, considers that it is truly part of the endo-skeleton, and not a mere dermal cuirass as formerly thought. He gives good reason for regarding the five pairs of narrow bones lying along the median ridge of the back as corresponding to the neural spines, and the six pairs of lateral shield-like bones as corresponding to the parapophyses of the vertebræ; while the long pointed bone at the hinder extremity he shows to be an inter-neural, as the first spine of the dorsal fin (in this fish crowded out to above the caudal fin by the bony cuirass) is joined to it. Anteriorly and laterally the modified humerus contributes to complete the armour-plating.

In consequence of the immense development of this bony sheath which really is a *roof* to all the animal but its head, no room has been left for the ordinary position of the dorsal fin, both the spiny and soft

parts of which are situated just under the narrow terminal portion of the cuirass and actually *behind the small caudal fin*! Further, the longitudinal axis of the tail cannot extend in a line with that of the body, and so is *considerably curved downward*; the caudal fin is very small and weak. The anal fin is also small and is close before the caudal; the vent being immediately before it and so very far back. The pectoral fins are poorly developed; they lie far back in a deep curve or hollow in the bony sheath, situated between the humeral and first broad lateral plates. The ventral fins occupy a middle position; they are so small as to be little more than rudimentary.

Below the body, from about the middle of the snout to the vent, the stiff investing skin of the sides below the bony cuirass is extended in the form of a sharp-edged, transparent keel, of unequal depth.

I have had no opportunity of dissecting this fish, but will quote what Dr. Günther says as to the extraordinary formation of the spine in *A. scutata*. "The structure of the vertebral column is extremely singular and perhaps unique among the Acanthopterygians. The abdominal portion is more than four times as long as the caudal; nevertheless it is composed of only six vertebræ, whilst the latter consists of fourteen. These abdominal vertebræ are extremely slender, the third alone being nearly as long as the whole caudal portion; they have a slight ridge superiorly and inferiorly and on each side; the whole portion lies in the uppermost concavity of the dorsal cuirass. The caudal vertebræ are extremely short, and the strength of the neural and hœmal spines is in proportion to their size. . . . . Amphisile may be considered as a Chelonian form among fishes."

The mouth is very small, without teeth, at the end of the much prolonged tubular snout. The skin has no scales.

Amphisile seems to afford a very striking instance of special modification for passive protection. Everything else seems to have been sacrificed to the closely-investing plate armour. Its extremely attenuated form, weak muscular development, exceedingly limited powers of motion, and very small mouth, all point to its being one of the feeblest of fishes, notwithstanding its formidable looking coat of mail. As it has apparently come down with little or no modification from Eocene times, it seems possible that so small a fish has succeeded in maintaining its existence by being at once too hard and too insignificant to be worth devouring.

Fishes of such weak powers of locomotion as *Amphisile* are quite at the mercy of sudden freshets or strong currents, and so must often be swept out to sea. *A. punctulata* is recorded from the Red Sea and Mozambique; but I believe the present instance is the first brought to notice of its occurrence so far to the southward as the coast of Natal.

Diagram I.

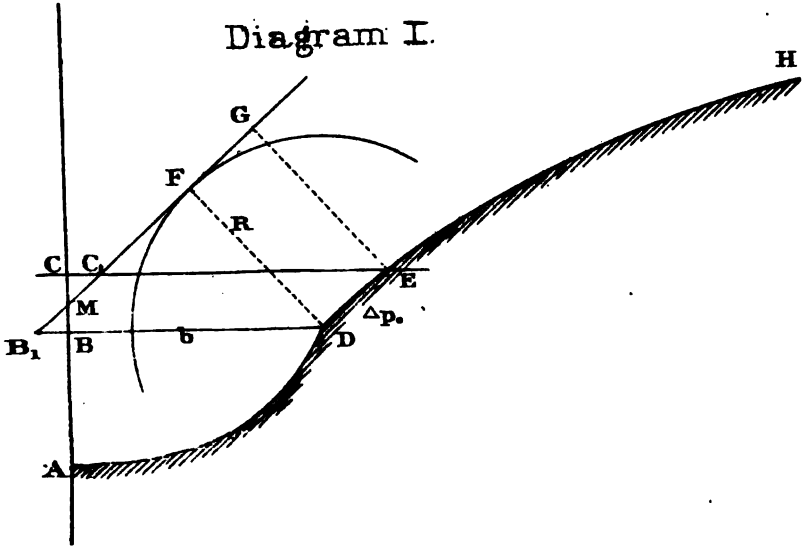


Diagram II.

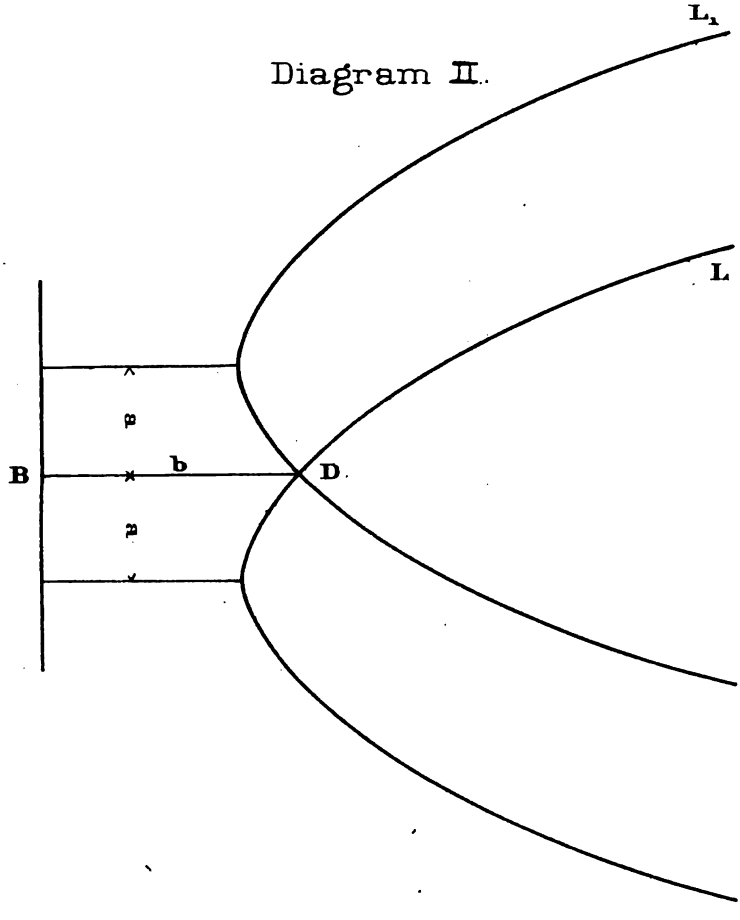
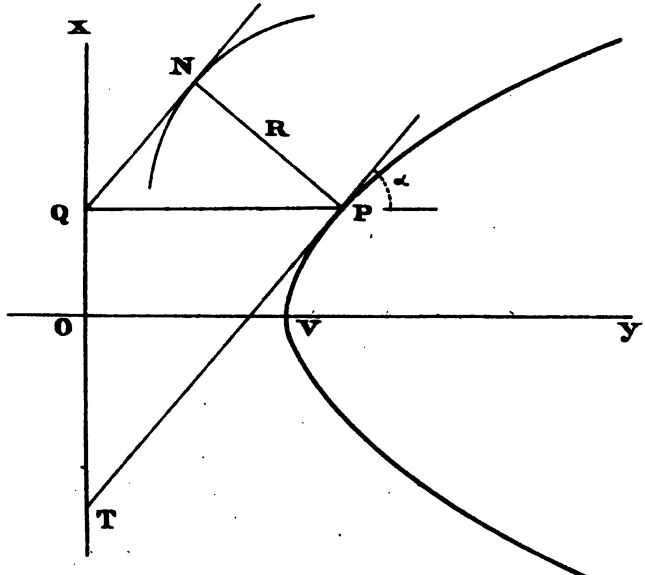


Diagram III.



XVI.—FORM OF CROSS-SECTION OF A CHANNEL FOR CONSTANT VELOCITY OF WATER AT DIFFERENT LEVELS, BY E. ELMGREN.

[Read by John G. Gamble, 26th September, 1883.]

1. Considering a limited portion of a channel, with a definite and invariable slope, we will determine a cross-section of such form as to give a constant velocity of water whatever the depth of the water in the channel.

2. Whatever formula we may use for determining the velocity of water in a channel, we shall always have the velocity a function of the "*hydraulic mean depth*" and the sine of slope. The last quantity being constant in our problem, this is reduced to the determination of a cross-section with constant 'hydraulic mean depth' for varying water levels.

3. It is easy to show that it is impossible to fulfil this condition down to the very bottom of the channel. For take a water level sufficiently low, then if b be the breath, h the greatest depth of water in this section, A the sectional area of the water, and p the wetted perimeter we have

$$\left.\begin{array}{l} A \leqq bh \\ p > b \end{array}\right\} \text{whence } \frac{A}{p} \text{ is less than } h$$

Hence lowering the water successively the 'hydraulic mean depth' (and consequently the velocity) will become zero while there is still some water in the channel.

4. Thus only the section above a certain level can be considered in our problem, and this level we will suppose to be the level of the surface at the minimum discharge of the channel.

5. We will consider a symmetrical section only. Let A_o represent half the sectional area ABD (diagram I) below the lowest water level and p_o half the corresponding wetted perimeter, then the hydraulic mean depth for the minimum discharge is

$$R = \frac{A_o}{p_o} \qquad \text{.......................................(1).}$$

6. Now let the water rise to the level CE. The increase in sectional area is ΔA_o, in wetted perimeter Δp_o, and the condition to be fulfilled is

$$\frac{A_o + \Delta A_o}{p_o + \Delta p_o} = \frac{A_o}{p_o} = R$$

from which follows

$$\frac{\Delta A_o}{\Delta p_o} = R \qquad \text{.......................................(2).}$$

7. This formula gives the following construction of the element DE, (see diagram I). From centre D with radius R describe a circle; from

M the middle point of BC draw a tangent MG to the circle; draw D E parallel to M G : D E is the element required.

Let the tangent MG cut BD in B_1, and CE in C_1, also let fall DF and E G perpendiculars on the tangent.

Then

$$R \Delta p_o = \text{rectangle DG} = \text{parallelogram } B_1 E = \text{trapezium BE} = \Delta A_o$$

Note.—As there can be drawn two tangents from M to the circle, another solution is possible, but this giving an inward slope to the element of the perimeter is postponed for the present.

8. From the construction it follows (for an infinitesimally small element) that a necessary condition, if the problem is to have any solution, is

$$R \leqq b \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

9. If R = b the element DE (infinitesimally small) will be vertical (and therefore as will be seen below the whole section).

10. The reasoning for another increase in depth will be word for word the same as in Art. 6 sq. taking A_o the whole area ABCED and p_o for the whole A D E. The construction of the next and following elements of the section will consequently be exactly the same as is given above.

11. Thus the required section may be, by this simple construction, built up of elements, which, if taken sufficiently small, will approximately give a curve the nature of which we will now investigate.

12. Taking AC as axis of x (origin need not be fixed yet) and supposing BD to be any level (the coords. of D being x and y), equation (2) gives, passing to limits

$$\frac{d A}{d p} = R$$

Now $d A = y\, dx$, and if we use the ordinary notation s instead of p, the differential equation of the curve becomes

$$\frac{y\, dx}{ds} = R \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

13. We may write this

$$\frac{dx}{R} = \frac{ds}{y} = \frac{dy}{\pm\sqrt{y^2 - R^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

of which the general integral is

$$\frac{x}{R} + C = \log_e \left\{ \frac{y \pm \sqrt{y^2 - R^2}}{R} \right\}$$

or

$$\left.\begin{array}{l} y \pm \sqrt{y^2 - R^2} = R e^{\frac{x}{R}} + C \\ y \mp \sqrt{y^2 - R^2} = R e^{-\frac{x}{R}} - C \end{array}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

hence

$$y = \tfrac{1}{2} R \left\{ e^{\frac{x}{R}} + C + e^{-\frac{x}{R}} - C \right\} \quad \ldots\ldots\ldots (7)$$

the equation to a *catenary*. The axis of the curve is horizontal and the distance of its vertex from the axis of x is equal to R. The condition that D (if D be the point from which we start) is to be a point of the curve serves to determine the constant C.

14. However, as we have not yet fixed upon any particular origin, we can select it so that C = 0. This results if for x = 0, y=R. The equation to the catenary then takes its simplest form

$$y = \tfrac{1}{2} R \left(e^{\frac{x}{R}} + e^{-\frac{x}{R}} \right) \quad \ldots\ldots\ldots\ldots (8)$$

If then *a*, *b* be the coords. of the point D, and these values for x and y are substituted in equation (6) we get

$$R\, e^{\frac{a}{R}} = b + \sqrt{b^2 - R^2}$$

$$\text{or} \quad \frac{a}{R} = \log_e \left(\frac{b \pm \sqrt{b^2 - R^2}}{R} \right) = \pm \log_e \left(\frac{b \pm \sqrt{b^2 - R^2}}{R} \right) \ldots (9)$$

whereby *a* or the situation of the origin is determined, since b is supposed to be a given quantity.

15. The two values of *a* give two catenaries, or two positions of the same catenary with their axes at equal height above and below B D. Only the branches above answer to the problem (see diagram II). If R = b the two coincide, *a* being = 0. If R > b there is no solution (cf. Art. 8).

16. Now if through any point P of either of these branches D L or D L$_1$, a water level be laid, the section below this level has its hydraulic mean depth = R. Hence we are in the same position with regard to this level as we were to the level C D, and consequently two other catenaries may be laid through this point P to continue the section, and so on.

17. Hence it follows that the section may be constituted of (the convenient parts of) any succession of catenaries with the same parameter R) or we may say any series of positions of the same catenary. This is the general solution contained in the equation (7). If these catenaries be taken infinitely close together, they will generate a perpendicular line at the distance R from the middle line or x-axis. The equation of this line is y = R which is the "particular integral" of equations (4) and (5).

18. The following negative corollary may perhaps be of some practical value value :—

No closed section can give the same velocity of water for all levels.

19. We will now give some properties of the catenary with regard to the present question. The differential equation (4) gives the following geometric construction. If P be a point on the catenary (diagram III), P Q its ordinate y; from P as centre with radius R describe a circle: Q N tangent to this circle; then Q N is parallel to the tangent to the catenary at P.

Let P T be this tangent cutting the axis of x in T.

$$\frac{dx}{ds} = \cos PTx \text{ and by (4) } \frac{dx}{ds} = \frac{R}{y} = \cos NPQ = \cos NQx$$

Therefore angle P T x = angle N Q x and N Q is parallel to P T.

20. We can show that Q N = s = arc P V (V being the vertex of the catenary.

$$\text{From (5) } s = \int_R^y \frac{y\,dy}{\sqrt{y^2 - R^2}} = \sqrt{y^2 - R^2} = QN$$

21. Triangle N P Q is equal to half the area O V P Q since

$$\text{area } OVPQ = \int_0^x y\,dx = \int_0^s R ds = Rs = 2 \times \text{triangle } NPQ$$

22. If a be the slope of the bank at any point whose ordinate is y, then $R = y \sin a$. This is the same equation as (4). And if we were to give the sectional element another slope $a_,$, the hydraulic mean depth of the infinitesimal element of the section would be

$$R_, = y \sin a_,$$

Therefore $R_,$ is greater or less than R according as $a_,$ is greater or less than a, i.e. according as the slope is taken to the left or right of the catenary. And it is easily shown that this is true of the whole section. We have here only considered the outward sloping practicable catenary; a similar theorem may be shown for the other one.

23. The condition of possibility (Art. 8 and 15). $R \leqq b$ is always fulfilled by any section at least that does not present any inward slopes, that is for every section than can occur in practice.

For $R = \frac{A}{p} < \frac{A}{h} < \frac{bh}{h}$ that is, is less than b.

NOTE.—For a rectangular section $R = \frac{bh}{b+h} = \frac{b}{1 + \frac{b}{h}}$

If h be infinitely large in comparison with b, R will approximately = b, but can never reach that value. Hence the particular solution (Art. 9 and 17) cannot be applied to the lowest level.

24. For calculation of the catenary it is better to introduce the angle of slope a

$$\frac{y}{R} = \frac{1}{\sin a} \qquad \text{.........................(10)}$$

$$\text{therefore } \frac{x}{R} + C = \log_e \left\{ \frac{1}{\sin a} + \sqrt{\left(\frac{1}{\sin a}\right)^2 - 1} \right\}$$

$$= \log_e \cot \tfrac{1}{2} a$$

(dropping the negative sign which answers to negative values of x) or if C = o

$$\frac{x}{R} = \log_e \cot \tfrac{1}{2}\alpha = (\log_{10} \cot \tfrac{1}{2}\alpha) \times 2{\cdot}3026 \ldots\ldots (11)$$

25. We will here arrange together in proper order the formulæ which are needed for a calculation of the section. Calling the velocity v and the discharge Q, and considering the suffix $_o$ to apply to the section below the level from which we start, be it the lowest or otherwise,

$$A_o = \frac{Q_o}{v}\ ;\ A = \frac{Q}{v} \quad \ldots\ldots (\alpha)$$

$$\sin \alpha_o = \frac{R}{b_o} \quad \ldots\ldots (\beta)$$

$$p - p_o = \frac{A - A_o}{R} \quad \ldots\ldots (\gamma)$$

$$\cot \alpha = \cot \alpha_o + \frac{p - p_o}{R} \quad \ldots\ldots (\delta)$$

$$b = \frac{R}{\sin \alpha} \quad \ldots\ldots (\epsilon)$$

$$h = h_o + R \log_e \frac{\cot \tfrac{1}{2}\alpha}{\cot \tfrac{1}{2}\alpha_o} \quad \ldots\ldots (\zeta)$$

(δ) can easily be got from diagram II, (ζ) is deduced from equation (11) in Art. 24, the other formulæ need no explanation.

The approximate graphical construction given in Art. 7 seems however much preferable to a calculation.

26. Since this was written the writer has found the subject treated in the article 'Hydromechanics' in the latest edition of the Encyclopædia Britannica, though in a very brief manner and only as far as regards the upper part of a channel section. The nature of the curve is not mentioned but a figure is given and attention is drawn to the rapid flattening of the bed.

27. The lower part of the channel section referred to in the Encyclopædia is half a regular hexagon. For this we have

$$h_o = b_o \cos 30^\circ = 0{\cdot}866\ b_o$$
$$2\,A_o = \tfrac{3}{2}\, b_o\ h_o = 1{\cdot}299\ b_o^2$$
$$p_o = \tfrac{3}{2}\ b_o$$
$$R = \frac{A_o}{p_o} = \frac{h_o}{2} = 0{\cdot}433\ b_o$$

We will calculate the dimensions of the section for a discharge three times as great as that which fills the hexagon part, that is for $A = 3A_o$

$$\sin \alpha_o = \frac{R}{b_o} = 0{\cdot}433. \quad \text{Therefore } \alpha_o = 25^c.40'$$

$$p - p_o = \frac{A - A_o}{R} = \frac{2A_o}{R} = 3\,b_o$$

$$\cot a = \cot a_o + \frac{p - p_o}{R} = \cot a_o + \frac{3b_o}{R} = 2{\cdot}081 + \frac{3}{0{\cdot}433}$$

$$= 9{\cdot}011 \quad \text{hence } a = 6^\circ\,20' \text{ (about)}$$

$$b = \frac{R}{\sin a} = 3{\cdot}92 b_o$$

$$\frac{h - h_o}{R} = \log_e \left\{ \frac{\cot \frac{1}{2} a}{\cot \frac{1}{2} a_o} \right\} = 1{\cdot}415$$

$$h = 1{\cdot}48\, b_o$$

From these results we find $\frac{b - b_o}{h - h_o} = 4{\cdot}78$ whereby the flattening is seen, as also because $a_o = 25^\circ$, $40'$ and $a = 6^\circ\,.\,20'$

28. The velocity must be such as not to scour the bed or slopes of the channel. A table of maximum surface, mean and bottom velocities for different qualities of ground is given in the aforesaid article in the Encyclopædia Brittannica.

29. This catenary form of section seems to be that which a river would naturally make for itself in a homogeneous soil, by scouring it away until its sectional area is so much increased, that the velocity sinks to the values given in the table mentioned. The principal counteracting agent is vegetation, which strengthens the banks, and thereby alters the conditions.

30. In conclusion, we may go a step further in generalisation of the solution of the problem, by adding to article 17 the remark that the section need not be symmetrical. So long as the wetted surface above the minimum waterlevel consists of portions of catenary curves with the parameter R, the axis horizontal and the vertex at a distance R from the centre of the canal, then the condition is satisfied, and the section solving the problem may have an infinite number of regular and irregular forms. Of course the only practical form is the outward sloping curve E H shown in diagram II. Note the rapid flattening of the bank.

NOTE.—By velocity in this paper is meant the 'mean velocity' of the section, i.e. that one which multiplied into the cross sectional area gives the discharge.

XVII.—IRRIGATION ON THE VISCH AND ZAK RIVERS, CALVINIA AND FRASERBURG DIVISIONS.—By Capt. J. A. Balfour, C.E.

[Read 1883, Nov. 28.]

The District of Calvinia is equal in area to 41,000 square miles, an extensive table-land sloping towards the great drainage channel, the "Orange River." It lies between the 19th and 21st degrees of longitude, and the 28th and 33rd degrees of latitude, where exists the debateable climatic belt. Consequently, it is subject to vicissitudes of drought and occasional heavy rains, the latter unequally distributed. These recurring droughts paralyze the graziers and agriculturists, cattle and sheep perish rapidly while they last, and the water channels are dried up. Recourse is then had to digging shallow pits to obtain water, which when found is often brak. This uncertainty of the water supply has heretofore retarded the efforts of the inhabitants to produce good crops although the soil is particularly adapted for that purpose. Within these last three years several of the farmers in the district have endeavoured to counteract the fatal effects of this recurring aridity by asking the Government for assistance in money under the "Irrigation Act" to enable them to construct storage reservoirs, or dams, weirs and furrows. It is to be regretted that their generally impoverished state has prohibited (in a degree) the Government extending all the aid to them it was anxious to do, nine-tenths of the farms being mortgaged. Until the possessors of these farms find a way out of their monetary engagements with bond-holders so as to enable them to benefit by the terms offered them under the "Irrigation Act" they are likely to remain the holders of unproductive farms. But if nature is fickle in her bounties to the majority of the Calvinia farmers, she is extremely generous to a few, viz., the lucky individuals who have purchased or leased farms on the "Zak" or "Visch" Rivers. These rivers have perfectly dry channels except when rain occurs within their drainage areas, then they are the bearers of mighty masses of turbid water. When the Zak reaches "Braszijn Plaats", fifty-five miles northeast of the village of Calvinia, where its channel is shallow it overflows its banks and waters the lands adjacent to it on either side. Its velocity being then retarded the silt is precipitated and forms a layer of rich natural manure completely covering the inundated area.

The approximate annual discharge of the "Zak" River may be put down at 209,088,000,000 million cubic feet, taking one-third of the rainfall only.* Along the banks of the "Zak" or "Visch" Rivers in the Calvinia District down to Brandvlei where the Zak loses its waters in the "Vleis" and flats, there is a series of twenty-five (25) farms of large area. Many of them belong to the "Van der Merwes" who have lately begun to utilize the periodical floods. At "Brandwacht" F. van der Merwe has built a weir of loose stones on a bed of rock in the "Visch" River, and has cut a good service-

* This is calculated at 9 inches rainfall per annum over the whole drainage area.

able channel from behind it to his sowing land. Branching from this main channel several subsidiary ones of smaller dimensions lead the water to the fields where it is allowed to run over the lands and deposit its silt. This main channel has a fall of somewhat less than two feet per mile. Its bottom width is nine (9) feet; the sides were originally cut vertical, but the water has given them a concave shape, or dished them: the length of the furrow to the bifurcation of the smaller ones is 3,230 yards. No deposit of silt has taken place; therefore it would appear that an inclination of something under two feet per mile* is sufficient to prevent a deposition of silt. The distribution is the reverse of economical, Mr. Van der Merwe not yet having made himself acquainted with any effective system, nevertheless the fertility of the soil enables him to reap from 50 to 70 fold. Fifty muids of grain have been sown this year at "Brandwacht" from which a return of 2,500 may be confidently expected as the minimum. On the same farm a large dam is in course of construction, the length of the embankment which runs across a "Leegte" is 2,000 yards with a mean height of twelve (12) feet.

The site is an excellent one, but the work is badly done; the section of the embankment gives 11 feet on top, slopes of 1½ to 1. The stones used in pitching the inner slope have been set with their edges at right angles to the slope instead of being embedded flat or on their sides. The earth work has not been rammed or trodden during construction, consequently the bottom part of it has become soddened with water. Leakage by oozing is general along the whole length. It is a pity Mr. Van der Merwe did not think it worth while to ask professional aid.

Proceeding down the "Visch" River the next farm below Brandwacht is "De Drift," the property of Mr. T. W. van der Merwe, who has also made a weir on the river and cut a furrow from it to his sowing land. The quality of the soil is similar to that of Brandwacht, but as his water channel is smaller, he has not yet been able to produce so much as Mr. F. van der Merwe.

The proprietor informs me that he intends widening his furrow. It is 5 feet at the bottom with vertical sides cut through rock slate, the whole length of 3,600 yards.

"Vliege Kraal" and "Stoffelsgat Kop" follow. At the former place (Karl van der Merwe's), nothing has been done. At the latter Mr. S. van der Merwe has built an excellent weir on the "Visch River" and cut a channel over 2,000 yards in length to his arable land. He availed himself of the provisions of the "Irrigation Act" by obtaining a loan of money from Government, consequently he had the advantage of professional advice. The weir is built of massive stones well laid. Its height is 6 feet from bed of river to crest: up stream slope one to one, down stream slope twelve to one. It is built upon the slope composing the river bed. Although it was late in the season before the work was completed yet Mr. van der Merwe was able to utilize the flood in the month of August last. This weir and furrow will enable Mr. van der Merwe to place 5,000 morgen under water.

* With a velocity of 3½ feet per second.

"Oude Muur" and "Wit Klip" likewise belong to Mr. Schalk van der Merwe. A dam is being constructed on the latter, for which a loan of £500 has been obtained from Government.

"Brassefontein" adjacent to "Oude Muur" is the property of Mr. Kingon of Fraserburg. No irrigation work has as yet been made, but assistance has been applied for from Government under the Irrigation Act to construct a large dam which will hold about 210 million cubic feet of water. The embankment will be thrown across the lower end of a "leegte" which drains an area of about 600 square miles. This work will be of great benefit when completed. I believe Mr. Kingon likewise intends cutting a channel from behind a weir to be built in the river. These two works will increase the value of Brassefontein to a great extent.

"Brazijn Plats," "Tontelbosch Kolk," "Middle Hoek van Spruit," and "Bakoven" come next. The first, Mr. D. Louw's, the three latter Mr. J. W. van der Merwe & Sons. These men are now reaping the benefit of the excellent position of their farms. Here the channel of the "Zak" is so shallow that ordinary floods overflow the banks spreading far and wide over the extensive flats bordering the river, depositing rich fertilizing matter, containing chemical properties peculiarly suitable to cereals. The preparation of the land at the last named places for the reception of seed has heretofore been of a primitive character; shallow ploughing, and in new land the bushes were not in many instances cleared away. The seed is sown very sparingly, otherwise the growth would be retarded by the density of the grain. *The average height to which the crops grow varies from five to seven feet and the ears measure from six to nine inches full and well developed.* After the first crop is reaped a second one may be expected without sowing.

The grain now growing at Tontelbosch Kolk is the third crop without sowing. Last year I have been told 1,600 muids were reaped off this farm and a very small area was sown. But no doubt a much greater return would be obtained if the ground were better prepared, more care taken to plough deep and evenly, the bushes and roots cleared away and the clods broken by rolling and harrowing. The threshing, cleaning and bagging has heretofore been done in the old primitive manner, cattle and horses tread out the grain in a circular threshing floor; it is cleaned of chaff by throwing it into the air when the wind blows, heavier substances are swept off with a broom and it is then bagged and stored.

Threshing was commenced in January and finished in June after an amount of labour which might have been effected by machinery in a fortnight.

Beyond these farms similar ones follow in succession as far as "Brandvlei." Beyond this the waters of the "Zak" are lost in vloors and valleys, the river not yet having formed a definite channel for itself. At "Lekkervlie" below "Hoek van Spruit" the proprietor has commenced to make a dam, he has asked a loan from the Government under the "Irrigation Act," which I believe has been favourably entertained by the Honourable the Commissioner of Crown Lands. A plan of the intended work has been given by Mr. Niekerk, the

proprietor, and when he receives the money the work will be commenced in earnest. At Brandvlei a small storage reservoir was constructed by the Government to supply the village and irrigate the erven. It has been of great advantage to stock farmers in keeping their cattle and sheep alive during the late drought.

From the above notes it will be seen that there is an extensive tract of the very best soil along the banks of the "Visch" and "Zak" rivers, offering a wide field for agricultural enterprise, and if the farms were all in the hands of industrious and intelligent men or divided into smaller portions to enable a larger population to exist this back part of the Colony would no doubt turn out a mine of wealth to South Africa.

XVIII.—ON DISTURBANCES TO THERMOMETER READINGS FROM LOCAL CAUSES.—By Andr. Smith, M.A.

[Read 1884, March 26th.]

The thermometers at Lovedale have been kept in a thatched wooden hut in the form of an octagon. The upright posts are pieces of quartering about seven feet high, and the sides are weather-bordered in the Venetian style. The roof is thickly thatched, the anemometer is fixed at the top at about ten feet from the ground, and the thermometers are attached to a post in the centre. Some time ago the Meteorological Commission proposed to issue the Stevenson thermometer crib to all the stations in the Colony, as it was supposed to be the best for the purpose, and also to secure uniformity, and a crib of this kind was sent to Lovedale. Though suitable enough in England, the Stevenson crib seemed to the writer liable to be heated by the strong solar radiation in this country in summer which would disturb the accuracy of the readings; and on this being represented to the Commission it was arranged that two sets of observations should be carried on at Lovedale for the sake of comparison, one in the Venetian hut and the other with a crib, and a second set of thermometers was supplied for the purpose. The Stevenson crib was placed quite beside the other Observatory on a slope where there is almost always a current of wind, and observations were made in both from spring till midsummer of 1882. There was a great uniformity between the two sets of observations, except that the dry bulb in the Venetian hut at eight o'clock in the evening stood usually two degrees above the one in the crib, a result due to the hut from its mass cooling down more slowly after the heat of the day. However, the experiment on this point seemed to be inconclusive and unsatisfactory as the constant current at that spot would prevent the crib from becoming heated, and so airy a situation would be exceptional.

The Stevenson crib was accordingly removed to an open space in one of the gardens where the air was comparatively still. The effect is this was immediate. The maximum-thermometer in the crib now stood in days of bright sunshine 2 degrees, sometimes 2½ degrees above

the one in the Venetian hut. The average maximum in a month was about 1 degree higher, but this lower amount was due to the occurrence of a large number of cloudy days during the two months of trial, and on such days the readings were the same in both. It may be noted that here, as in many similar cases, real and marked differences are drowned in averages, and this is especially the case when things inconsistent and opposite are mixed up.

It was thus proved so far that the maximum in the crib was disturbed by solar radiation to the extent of 2 degrees or 2½ degrees. Still it remained uncertain whether this was due to the heating of the crib itself, or to the heating of the still air within hedges, or to both, and in what proportion. A sheet of calico was therefore placed as a screen, about one foot above the crib, so as to shade it from the sun. The effect of this was somewhat surprising. The maximum thermometer stood now habitually one degree lower than the one in the Venetian hut. This apparently indicated that the Stevenson crib in bright sunshine, and when not in a current of wind, heats the maximum thermometer to 3 degrees or 3½ degrees above the temperature of the air. It also brings out the fact of a similar disturbance in the Venetian hut, for, as had been suspected, the weather boards, though painted white, become heated under the sun rays, and radiate heat to the thermometers. There is sometimes a confusion from mixing up *conduction* and *radiation*. It is supposed that hot air in contact with heated boards in a crib or Venetian hut cannot heat the thermometer because it is carried away; but if conduction is prevented, radiation from the heated wood remains, and it will heat the wood of the thermometer itself, or its support, unless there is a decided current of air. The high readings of thermometers placed under verandahs are accounted for by radiation from heated wood or corrugated iron. A thermometer on a hot-wind-day placed completely in the shade attached to a cypress, read 115 degrees, when 105 degrees was enough. Unless the thermometer was very incorrect you would refer the high reading to strong radiation from the hot ground a little in front, and the consequent heating of the trunk of the cypress and the wood of the thermometer.

A disturbance of the Stevenson crib by solar heat is also indicated by the maximum temperature being sometimes reached between 4 o'clock and 5 o'clock in the afternoon. This is too late, and must be referred to the west side being heated by the sun.

There are some other differences between the observations at the higher station and those at the lower or Stevenson crib. The lower is colder in the morning, and there is a less difference between the dry and wet bulbs, indicating greater humidity. These differences are due to the greater radiation of the heat at night in the stiller air, and to proximity to the watercourse. The discrepancies are greater than one would look for in places within 300 yards of each other; but differences due to locality may be left out of view for the present.

The morning reading in the Stevenson crib is also affected in summer by the three hours of sunshine from 5 to 8 a.m. The amount of this can be determined from two cribs, one in the shade.

The maximum thermometer has not received the consideration in meteorology which it deserves in comparison with the mean annual temperature.

At Lovedale this mean is nearly six degrees below that of East London, the elevation being 1,750 feet. A difference like this ought to make the climate and productions very different, something like the south of France and the south of Spain, which have a mean annual difference of six degrees. But on the contrary, leaving out some things which are tender to frost, such as bananas (and even those are grown at Chumie Peak near Lovedale, a spot too elevated and dry for hoar frost), the seasons and the productions at Lovedale and East London are nearly the same. The reason for this is that at Lovedale the extra cold is put into the winter and into the night. The heat of day and of summer is much the same. This will sufficiently show the importance of the maximum thermometer as the only index to the heat of day and the heat of summer, according to our usual mode of observing.

The question which remains is how to get rid of local disturbances in observing temperature.

The Venetian thatched hut must be rejected. It is much too expensive, and is inaccurate, both from its slow cooling at night, and also because a thermometer, hung between the centre and the east side, reads a degree too high in the morning, and corresponding one nearer to the west side reads a degree too high in the afternoon. This is due to radiation from the boards, and it is observable that if there is anything wooden behind the thermometer, that makes it hotter, when heat is radiated towards it, than when it hangs quite free, as glass and mercury are bad absorbents. A simple roof supported on poles has been employed, but it is not very easy to screen the thermometers hung under it from the sun below 45 degrees, and from rain.

The solution of the difficulty seems to be this—to adhere to the Stevenson crib, but to shade it from the sun by enclosing it in a light frame of rod-iron, covered with white Russian canvas or strong cotton sheeting. The door of the crib would face the south, it would be screened from the sun on the east, north, and north-west sides, and above, while below it would remain open. The distance between the canvas-cover and the crib might be from eight inches to a foot.

A wooden frame would do if rod iron could not be got. Besides screening the crib effectually from the rays of the sun, the cover would prevent radiation at night from the crib as a solid, if there be any sensible amount. It is of some consequence that the canvas should be white, so as not to become heated. Everyone who puts his hand on wood painted with purest white lead, and on wood painted any other colour or unpainted, will know the value of white to ward off heat.

The plan of having the Stevenson thermometer cribs at all stations screened from the sun in this manner would occasion some expense at the outset, and the canvas would require renewal after a time, but it would be better to incur the necessary outlay than to go on for a term of years accumulating observations of no scientific value.

In case it might be supposed the one degree or two degrees of

Fahrenheit is an inappreciable quantity not worth attending to, reference may be made here to some common things of easy observation, which show that very marked differences in climate, in productions, and in agriculture are the effects of two degrees difference in summer heat.

We may take for comparison a county such as Hampshire, in the South of England, one in the middle of England, and another in Scotland. The winter temperature may be neglected, as the line of equal cold is about parallel to the East Coast.

Taking a wood in the middle of England and one in Scotland, you will observe such differences as these. The month when the trees are in full leaf in the former is May, in the latter June. Acorns and beech-mast are so plentiful in the one, that swine are sent there to feed on them—[hence the surnames confined to England, the Howards and Hogarths, the professions hogards or hog-herds,]—and squirrels are numerous; hazelnuts, walnuts, filberts, and even chesnuts ripen. The wych-elm is seen beside the common elm by the roads, the willow trees are plentiful near the rivers, and the misletoe is common. In a wood in Scotland the acorns and beechmast are valueless; squirrels are rare; the larch and other fir-trees abound; the Spanish chesnut is merely an ornamental tree, and hardly forms its fruit, the misletoe is rare, children do not search for nuts, but for blaeberries (bilberries) and cranberries, and in place of the willow the mountain streams are fringed with the alder and the birch.

Agriculture is also different. In the warmer locality wheat is grown on any heavy soil, meadows producing meadow-hay are common, fields are laid out in permanent pasture, and are top-dressed with manure. In the cooler, wheat is raised only on the best soils, meadows are not found profitable, and hay is made only from rye-grass, natural pasture has always been in a state of nature. General harvest in the one is in August, in the other it is in September.

In the usages of domestic life there are also differences, traceable to a difference of temperature. With the warmer temperature butter is brought to the table more or less salted, and beer is a common beverage. In the cooler the butter used in summer is sweet butter, a term which means having no more salt than nature has supplied, and with the somewhat keener air and less perspiration there is a distaste for quantities of cold liquid, and beer is not a common beverage.

In Nature, and especially in regard to the migration of birds, the differences occasioned by one or two degrees of summer heat, more or less, are very numerous. The arrival of the swallow and of other birds of passage is a good deal earlier, and their departure latter in the warmer locality. In the South of England the nightingale is common enough, in the middle one it is heard now and again, and curiosity makes people go some distance to hear its note, while in the north it is unknown even as a rare visitant, and the glow-worm also disappears. In the cooler region the partridge is accompanied by the black cock and grouse on the moors. The winter migration is reversed, and the gannet, the gull, the guillemot, with some other Arctic birds, know where to draw the line in their migration south.

Facts like these which might be multiplied indefinitely are enough to show that one degree or two degrees Fah. is an important factor in nature, and cannot be neglected if sound deductions are to be made.

Not much has been done in this country as yet in connecting the laws of temperature with the observation of nature. The periods of song in the common singing birds, and the times of migration of the birds of passage are worthy of attention. Observers, like White of Selbourne, are wanted at various spots in South Africa. I do not know if the South African Philosophical Society would undertake to call for such observers and summarize and tabulate the results of the observations. The isolated and unconnected labours of individuals otherwise come to nothing.

The connection between temperature and cultivation is also important. A few questions ought to be settled from what is already known on this subject without an appeal to vain experiments. We are beyond the coffee line in the colony, and the line for the castor-oil plant, and even cotton. These things all run the same road— a fair beginning, a precarious existence, and then a blight or disease that kills the plant. On the other hand we are within the area for the olive, the cork-oak, the silk-mulberry, the evergreen oak, the chesnut, and in fact everything called classical, whether plants, animal or bird. Tea is also quite a possible culture if suitable soil could be found, not for export but for local use. The question about the olive deserves special attention. Among the innumerable soils in the colony—marl, stiff clay, limestone, disintegrated shales and granites, karroos, and others, some soil ought to be found fitted for the olive, and if so, a few patches in Tuscany will bear evidence how great an industry the production of olive oil might become. As to the culture of silk, nothing will ever be done till families from Lyons and Lombardy introduce it, as the Huguenots did the production of wine.

To make possible, however, the application of the laws of temperature to the observation of nature, to cultivation, and to related subjects, it will be necessary to accumulate accurate observations in regard to summer-heat and winter-cold, and to both as connected with elevation and distance from the sea. These are of more importance than mean annual temperature.

XIX.—OTHER DAYS IN SOUTH AFRICA.—By Colonel J. H. Bowker, F.R.G.S., F.Z.S., &c., &c.

[Read July 30th, 1884.]

In whatever circumstances we may be placed, it is pleasant to fall back upon the occurrences of our childhood, and draw from the memories of the past; and conjure them up at will to suit our fancies, and more so when the face of nature has been so changed, that the country and its surroundings would not be identified by those who rest from their toil, under the quiet sod of the fields, over which they

hunted at pleasure, in the days before the wild game had given place to the sheep and cattle of the farmer, days when the lion was the real lord of the domain, and counted the wild Bushman and Koranna hunters amongst his vassals, ever ready and even willing to do his behests (get out of his way) upon finding they were intruding, or as often happened in the ups and downs of savage life, working for mutual benefit. There are days when the hunter meets with disappointment; game is wild, wind from the wrong quarter, grass too wet for creeping under its cover as the bow string would not do its duty. The poet speaks of "bow string when relaxed by rain," so it was with the Bushman, and when compelled to resort to strategy he would bide his time and a herd of game would be driven over the lair of a lion, knowing well that his confederate would be awake to the chance Unfair means were sometimes resorted to; when the lion had killed, the drill (fire) stocks would soon do their duty and lighting the grass to windward and following up the line of the fire compel the reluctant owner to relinquish his spoil, under protest (no doubt). Such surreptitious modes of depriving a brother hunter of results of his honest labour it is to be hoped were but few and not often resorted to, knowing that it would lead to reprisals in the end. The pioneers of South African civilization often found it necessary to keep up a sort of armed neutrality with the lions, and it was only when one took to cattle killing that the friends and neighbours assembled and hunted the intruder to death. Pringle relates a story of this sort in one of his poems; and when shooting in the wilds, north of the Orange River in 1867, the Boers told us the same thing. The hills were swarming with lions but they never molested them without just cause. The country at that time was covered with countless troops of antelope, &c., and the lion at home met us at unexpected short intervals and often we were under the necessity of deviating from the track taken. We were not slothful and yet there *was* a lion in the way, and what was more the beast disputed with success the right of way, and not being in a position to raise the question we accepted the situation and passed by on the other side; it was however not always so, and sometimes when in an agressive mood we fought and slew him and had our revenge for past insults. It was however a dangerous game to play and far from rich; in case of accident we fell into the same line as the wandering Boers and gave them a wide berth. The breech-loader had not then been thought of, and the denizens of the fields and fells would hold their own; but all is now changed. The railway whistle is heard, where only a few years ago the snort of the wildebeest, or whistle of the reybuck, broke upon the ear, and the Bushman has gone. with the rest *his* richly stored pastures have become private property. This, together with the temptation met with in (what was not to him), civilization, has stamped out a race who for many traits of character have not left their like behind; but it is not the Bushman alone; the thoughtless happy Koranna of the Diamond Fields is fast following in the same track to oblivion. When the nineteenth century was still young, a number of Bechuana refugees, from the valley of the Caledon River (people who had survived the

raids of Motselekatse, and other South African Attilas) were brought into the colony, and distributed amongst the frontier farmers; two of these families were handed over to my father, who had settled in Lower Albany; amongst them, was a boy who soon picked up a smattering of English, and his quaint way of telling over the vicissitudes of his past life was most interesting to us, and illustrative of what had occurred in the wilderness, amongst wild beasts, and wilder men. The former only killed to satisfy their daily wants, while the latter slew, for the pleasure of slaying. The people we took over were from the valley of the Caledon River, which by its main stream from the Jammerberg to its sources divides the Orange Free State from what is now Imperial Basutoland.

Graham's Town, which then consisted of a few scattered houses, was the only seat of Magistracy on the frontier, and it was there that they first saw the abodes of the white man, whose manners and customs were no doubt strange to the children of the wilds, as the poet says, and truly says,

What can we reason but from what we know.

Prostrate in front of the Landdrost's office and awaiting their turn to touch the pen and thus become the indentured property of a stranger, they naturally looked around, and one of the objects which drew particular attention was that of a gentleman pacing up and down the verandah, and no doubt enjoying his little constitutional before dinner. "What was he doing it for, and why he did not sit down?" was the puzzle, and to quote the boy's words, "He keep on walking up and down in front of the door looking at the ground and never speaking to any body; we say perhaps he is thinking about killing somebody."

Amongst other resources to which they had fallen for subsistence, was cannibalism; and to quote the boy's way of telling the story, "We catch a lad, or a lass, we don't know, we just cut him up and put him in the pot, and think he is a buck." This was told while helping to skin a bushbuck, and probably sent his memory back to the past. Their domestic arrangements, according to his account, were simple in the extreme; but probably rendered so by the precarious tenure upon which all held their lives and living. "When a woman have more than one baby at a time, the old women come together and pick out the fattest, which they give back to the mother. The other one they put dry sand in its mouth till it is dead."

Driven from the plains, and forced to seek refuge in the caves and rocks of the Malutis, amongst other modes of meeting daily wants, was that of watching the vultures sweeping past below them; and, when satisfied that they had a quarry in view, the line taken by the birds was followed in hot haste (knowing that the lions had killed not far off); sometimes the pursuers got to the spot, before the real master of the situation had finished his early breakfast; and when this was the case, they had to "*sit* with the vultures" at a respectful distance, until the lord of the feast had left; and then came their turn to close in, and secure the remains, and scramble with the birds for possession of the bones and refuse; armed as they were, only

with a pointed stick for digging roots, and scantily clothed in the remains of the last torn skin, recovered in like manner, their position was certainly not that of lords of creation, and therefore they had to accept the second, or perhaps third place in the scramble. An old woman who had managed to find her way down to the Colony, with the younger and abler, used to bask in the morning sun at the back of our dairy, while the milk was being churned; and then take a long drink of buttermilk when the butter had been taken off. This was in the good times, before Kaffir war, and lung-sickness, had decimated the then large herds of the frontier farmer; and when the butter was salted into casks, and sold for exportation to some foreign market; and three pence the pound by the hundred weight was thought a remunerative price. Our dairy was situated on the sloping side of a hill; and a gutter was dug through the soil, into which the buttermilk was shot after all had been served. The first morning of the old woman's was most amusing; after drinking two or three quarts, she watched the succeeding operation with great interest, and when the churn was turned over, and the remains of the buttermilk thrown into the gutter, exclaimed with uplifted hands, "Oh why have I not a belly big enough to hold it all."

Time went on, and our old Basutos were almost forgotten. We had grown to manhood, and like the rest of the world went out to seek our fortunes, chances and ups and downs placed me, after many years, in the responsible position of High Commissioner's Agent of the newly annexed territory of Basutoland, with instructions to maintain peace between the Free State and the Basutos. To while away the weary months, amongst other things I began a series of enquiries into the past history of the people, and was soon convinced, beyond all doubt, that cannibalism had not only been carried on in former times, but had been practised up to a recent date. There was but little disguising it, and the people when questioned spoke freely of it, as first a necessity, and then a choice.

Returning from a visit to Molepo's in the autumn of 1868, I procured a guide and went for the Putrasena Caves; most of them had been cleaned out of bones and used as places of refuge during the late war: but one I was told of had been but little used from the difficulty of driving cattle into it. We struck for this one, and were not long in arriving at the opening leading to the large cave; it was situated in a broken stratum of the huge sandstone cliff overhanging the Putresana Valley; in a pretty situation, with broken ridges, and here and there a patch of grass and bush; the guide was a strong looking young fellow, who had been born in the cave. There was a certain amount of romance about his history and parentage.

His story was that his father lived in the cave, and was a leading cannibal in his time. In one of his raids three girls were captured and brought in alive; one, his mother, was a good looking girl, and found favour in the eyes of the hunter, who took her as his wife; while the other two went to stock the general larder. Following the guide down a deep water-worn cleft in the rocks, or as I might better term it, a hand-and-foot path for some distance, we came to the mouth of

a large cave, or overhanging rock, facing to the westward and running for some distance into the hill side; the floor was almost level, and had been used as a goat kraal during the late war. The arched roof was blackened with soot which had accumulated there for years, and had found its way into the gloomy recesses of this "Chamber of Horrors:" here and there were the bones of different animals, including a few human ones, but mostly those of pigs or goats. However, after going to the outside of the cave where it sloped off through some stunted bush and grass towards the river, I found it completely covered with the burnt or charred remains of human beings. They were in all stages of decay, from those half buried in the earth, to others of a more recent date; some of the broken pieces of skull, which had fallen so as to form a little cup, were full of earth and small ferns or moss growing in them. In addition to bones, I found that the ash middens contained large quantities of human teeth and small bones of the hands and feet. The skulls were mostly broken in pieces, by some heavy instrument, others bore the marks of an axe; the leg and arm bones had been mostly split up for the marrow, leaving only the joint-ends. I collected as many pieces as I could conveniently carry away, selecting those which bore the marks of fire or cutting instruments about the throat or neck-joint; my guide who could remember the tribe before broken up by Moshesh, pointed out the different places of interest; a little cave was shown as the place where he was born, and where he had passed his childhood's sunny hours; and at another spot was a shelf several feet above the floor, which was used as the larder; there the meat was kept; and a little further back was a gloomy hole, where the captives were kept alive—during the cold season all were killed; but during the heat of summer some were kept for a few days, to prevent spoiling on their hands; any attempt to escape was settled by a leg being broken, which was always effectual.

The modes of killing were various, the hot blood was a favourite drink for the weary hunter, and a limited supply was sometimes drawn from a finger or two; but this often ended in the body having to be carried home. In most cases the captives were brought in alive, a rope or reim was put round the neck, and the unfortunate creature held down by the united strength of several people according to the strength of protest, while they drew the reim tight; and a smart blow upon it, broke the neck; the body was then left to get cold; then it was cut up, and divided out according to the different claims, or number of family. Relatives did not eat each other; but a sort of exchange could always be made with a neighbour.

The Revd. Mr. Cassalis gives the date and time when the gangs were broken up and dispersed amongst the other portions of the tribes. One story which was related to me is too good to be lost. Moshesh's father met with the same fate as a number of others, and was eaten by the cannibals. This occurred many years before; but when it was proposed by one of his councillors, that extermination of the whole gang was the best, the old chief, who was anxious to strengthen himself against outside enemies, evaded this course by saying, "No, we must not destroy our fathers' graves." I never had an opportunity of

visiting the Korannaberg, Veerfoot and Mensvreeters (Maneaters) Mountain in the conquered territory; but was told upon good authority that similar remains were to be met with in the caves upon the sides of those hills, as in Basutoland Proper. Other caves along the foot of the Malutis had all been cleared during the war by those who had taken shelter in them.

Curious stories were rife amongst the people, how that there were night prowlers who associated with their fellow-men during the day, but when darkness set in went their rounds for the purpose of stealing children, puppies, sucking pigs, or whatever was handy; and, when a take was made the party collected together, went to some secluded spot, and, like the ghouls of eastern fable, had their feast. A story was told to me as having occurred at a kraal not far from my camp at the Korokoro, and shortly before we came into the country, in which a woman was sleeping in her hut with a baby in her arms, when, between sleeping and waking she felt the child being drawn quietly away; clutching fast hold of the feet she held on with all her strength—a real case of "Pull devil, pull baker." The cries of the child against such treatment being likely to arouse the people in the neighbouring huts, the unknown one relinquished his or her hold, and all search round was vain, and beyond a little shred of torn skin kaross, near the narrow doorway, nothing was ever found; but the impression was that it was one of a gang of men and women, who were hanging about the kraals, without any clearly defined way of obtaining a living. I tell the story as it was told to me. What I have related about the cave cannibals is a matter of history; and further research would lead to further evidence. The ornaments got from them were made chiefly of small bits of bone drilled, or teeth drilled for necklaces and armlets, while the drinking cups (like one I have used myself in Newstead Abbey, when on a visit) were made of the skulls of the slain, and very good dippers they would make. I could get none, but was told that there was or is a good collection in the Paris Missionary Museum.

The weapons used were much the same as we meet with at the present day,—club, shield and spear. Most of the caves were or had been in use as dwellings for ages; and numbers of pre-historic stone implements were strewed about; but none of the people could remember ever having seen them in use, and seem to think they had been brought there by the Bushmen. Some of the collection, bones, stone implements, &c., are now in the Cape Town Museum, others I sent to the late Sir Charles Lyell. In conclusion, I may add that the substance of the above was communicated to the "Cape Monthly," and appeared in print early in 1869. Holding the appointment of Chief Agent in the country I had some delicacy in putting my name to it; this, however, did not prevent others from doing so. It went the round of the newspaper world of the day, and was translated into different languages. I met with it in, "All the Year Round," as the result of the researches of a Mr. Leyland. Who Mr. Leyland was I do not know, but probably some unscrupulous pirate, who made up his travels as some make up a library, by affixing their names to a book and trusting to its being sent in some day with an apology for its having been kept so long.

XX.—FIRST CONTRIBUTION TO THE SOUTH-AFRICAN COLEOPTEROUS FAUNA.—By L. Péringuey, Member of the Entomological Society of London, Société Entomologique de France, &c.

[Read 1885, May 27.]

Family: CARABIDÆ;

Tribe: Omophronidæ, Lacordaire.

Genus Omophron, Latreille.

No. 1.— O. australe (nov. spec.).

O. pallide-testaceum, capite maculis duabus latis viridibus; prothorace plaga viridi postice notato; elytris fascia communi pone medium bi-sinuata maculisque duabus virescentibus in medio notatis.

Long. 7m.m., lat. 4m.m.

The head is broad, deeply punctured on the sides with a hollow impression in the middle, and with a triangular green patch above the eyes, coalescing at the base.

The prothorax is twice as broad as long, strongly lobed in the middle at the base, moderately convex above, with a protuberance on either side of the disc, and a deep transverse impression a little beyond the middle, extending to the sides. It is pale-yellow, like the head, with a patch of glittering green extending in front from one protuberance to the other, and limited behind by the transverse impression.

The elytra are pale-yellow, ovate, moderately convex above, each elytron with fifteen lines of punctures. In the middle of the disc there is a large bi-sinuated ferruginous green patch; the first sinuation reaches the sixth stria; the second, slightly curved backwards, reaches the eighth stria; on each side are two spots—one, basal, small, placed on the ninth stria; the other, larger, placed over the ninth and tenth striæ.

The suture is infuscated at the base; the infuscation, which in some specimens is greenish, unites sometimes with the median patch.

The under side is ferruginous in the middle, and pale-yellow on the lateral and apical sides.

Captured on the Cape Flats, in the month of June.

In my Collection.

No. 2.—O. HOTTENTOTUM (nov. spec.).

O. ferrugineo-testaceum, capite maculis duabus virescentibus, prothorace plaga virescente postice notato; elytris fascia communi postice ramulum emittente, maculisque tribus in singulo ornatis.

Long. 7$^{m.m.}$, lat. 4$^{m.m.}$

The head and prothorax are like those of the preceding species, but the spots on the side of the head, and the patch of the prothorax, are coppery-dull-green.

The median patch of the elytra is broader, ovate in the middle, with an apical sinuation forming a transverse spot; the base and upper suture are infuscated, the basal spot is much larger, the second one in the middle, also larger, and there is a third one near the apex coalescing sometimes with the sinuation of the median patch.

The underside is ferruginous.

Captured near Fraserburg, Cape Colony, in the month of February.

In my Collection.

Tribe: Brachynidæ, Lacordaire.

Gen. BRACHINUS, Weber.

No. 3.—B. VITTATICOLLIS (nov. spec.).

B. rufo-testaceus, sub-opacus, pubescens; prothorace cordato, medio canaliculato vittaque nigra notato; elytris sub-costatis, nigris, in singulo macula sub-humerali elongata fasciaque apicali sinuata flavo-testaceis.

Long. 8$^{m.m.}$, lat. 3½$^{m.m.}$

The head, ovate, reddish, finely punctured, has a deep impression on each side, and on the vertex a small black patch. The antennae are reddish, the third and fourth article are darker than the rest, the palpi are also red.

The prothorax is red, cordiform, marginated all round; the posterior angles are very acute. It is very little convex above, finely aciculated, and in the middle of the disc, there is a deep groove and a broad black line covering it.

The elytra are black, nearly twice as broad as the prothorax at the base, slightly ampliated posteriorly, rounded at the shoulders, sinuated at the apex, very little convex above, slightly shagreened, obsoletely striated, and pubescent. Near the shoulder and reaching the margin. there is on each elytron a somewhat elongated spot and a sinuated patch near the apex. The latter patch has two sinuations; the point of the first one reaches faintly the suture, the other follows the margin and reaches the outer apical angle.

The pectus and sides of the abdomen are black, the legs testaceous.

Captured near Cape Town.

In my Collection.

Genus CREPIDOGASTER, Boheman.

No. 4.—C. FUSCO-PLAGOSUS (nov. spec.).

C. flavo-testaceus, sub-opacus, capite prothoraceque crebre punctatis; elytris subtiliter granulosis, punctato-striatis, plaga magna dorsali apice valde sinuata, in singulo notatis.

Long. 6m.m., lat. 2m.m.

The head is ovate, finely punctured, the palpi pale yellow, the eyes black.

The prothorax is elongated, a little broader than the head, much rounded at the apex, narrowed past the middle, and so finely punctured as to look rugose; in the middle of the disc, there is a very thin hollow line.

The Elytra are very much shorter than the abdomen, broader than the prothorax at the base, slightly ampliated from the middle and much emarginated at the apex. Each elytron has 7 striae filled with close punctures, apparent only in the anterior part and from there disappearing altogether; there, the elytra are finely shagreened. Past the anterior third part is a fuscous dorsal patch, running along the suture as far as the apex, and so strongly sinuated at the apex as to leave a round space of a lighter hue than the rest of the elytra. The infuscation invades neither the suture nor the outer margin, which is slightly pubescent.

The underside and legs are pale-yellow; the abdominal segments are infuscated, with the exception of the apical one which is distinctly pale-yellow above and under.

Captured on the Cape Flats.

Allied to C. *bi-maculatus* Bohem., and may prove to be a distinct variety only.

In my Collection.

Tribe: Graphipteridae, Lacord.

Gen. Piezia, Brullé.

No. 5.—P. albo-signata (nov. spec.).

pl. 1. fig. 1.

P. nigra parum nitida, capite utrinque vitta albida pubescente; prothorace modice convexo, brevi, lato, punctato, extus pube albida marginato; elytris ovatis, supra planis, obsolete striatis, extus pube albida marginatis, in singulo lineis albidis quatuor medium disci attengentibus maculaque apicali albida ornatis.

Long 15m.m., lat. 8m.m.

Black, little shining; head rather large, punctured, with a deep impression between the eyes and with a line of whitish hairs on each side. The antennae are black with the articles 8.9 enlarged and compressed.

The prothorax is slightly broader than the head, moderately convex in front, tapering towards the base, with a deep arcuated impression near the apex and a small groove in the middle; the lateral margins are thickly coated with whitish hairs. The scutellum is small, and triangular.

The Elytra are ovate, much broader than the prothorax at the base, rounded at the humeral angles, truncated at the apex, almost plane above, deeply punctured, covered with a brownish down, and each elytron with four depressed lines filled with whitish hairs and disposed as follows: the first line beginning at the base runs parallel to the suture and does not reach quite the middle of the elytron; the second line is a little shorter than the first and has a little spot at a short distance from it situated in the middle of the disc; the third line reaches the third part of the elytron, there ceases, and begins a little further reaching the same distance as the spot of the second line; the fourth line is carried further than the other three, reaches beyond the middle of the disc and is three times interrupted. The lateral margins are coated with white hairs, and on each side of the apical suture, but not reaching it, there is a large white patch semi divided in two, faintly coalescing with the lateral margins.

The vestiture of this insect resembles much that of the *P. laticollis*, but the insect itself is smaller and the disposition and number of the white lines are very different. The interruptions in the fourth line from the suture may be accidental, because in the unique specimen I possess, that line is only interrupted twice on the right elytron.

From Rustenburg, Transvaal.

In my Collection.

Gen. GRAPHIPTERUS, Latreille.

No. 6.—G. UNIVITTATUS, (nov. spec.).

Niger, sub-nitidus, capite utrinque vitta longitudinali fulvo pubescente; prothorace punctato, medio tenue canaliculato, lateribus pube fulva tectis; elytris ovatis, obsolete striatis, breviter pilosis, vitta discoidali margineque fulvo-pubescentibus.

Long. 14m. m. lat. 6m. m.

The head, not very large, is punctured and has a deep impression on either side filled with fulvous, somewhat whitish hairs. The antennæ are black, dilated, and very much compressed.

The prothorax is not broader than the head, slightly convex and much attenuated at the base; it has a small longitudinal groove in the middle and the outer sides which are slightly marginated have a narrow band of fulvous hairs.

The elytra are ovate, slightly elongated; the humeral angles are much rounded; they are plane above, punctured, faintly striated and covered with a short, deep-black pubescence. On each elytron there is a longitudinal narrow line (vitta) nearer to the suture than to the margin, of fulvous-yellow hairs which does not begin quite at the base and roaches the apex. On the outer margin is a band of whitish-yellow hairs not broader than the discoidal one, which rounds the apical margin but does not unite with the discoidal band.

The underside is infuscated, and the first and second abdominal segments aciculated. The legs are black, and the tibiæ very slightly infuscated.

This species belong to the section B of de Chaudoir's Monographie des Graphiptérides.—"A. antennæ extus dilatatæ,"—and is doubtless allied to *G. lugens*, de Chaud.

Hab. Interior of South Africa (?)

In my Collection.

Tribe: Scaritidae, Lacord.

DYSCHIRIUS, Bonelli.

No. 7.—D. ORNATUS (nov. spec.)

D. rufus, nitidissimus, prothorace globoso, laevi; elytris oblongo-ovatis, punctato-striatis maculisque laevibus tribus elevatis in singulo positis, scilicet: prima ad basim suturae, secunda in medio, tertia ad apicem; antennis pedibusque infuscatis; tibiis testaceis.

Long. 5$^{m.\ m.}$ lat. 1½$^{m.\ m.}$

Reddish, shining. The head has two longitudinal well marked impressions; the four first articles of the antennae, the upper lip and the apex of mandibles are reddish black.

The prothorax is very convex, globose, smooth, slightly marginated, and with two rigid setae on each side, one near the apex, the other near the base.

The elytra are elongated, convex above, rounded at the shoulders, with rows of deep punctures; on either side of the suture at the base there is a smooth callus, another elongated and infuscated filling up the second and third striæ, and below it there is an elongated patch, infuscated in the anterior part, extending from the suture to the lateral margin and nearly reaching the apex.

The under side is shining—brown, the femora slightly infuscated, the tibiae and tarsi pale-yellow.

Captured on the Cape Flats, in the month of July.

In my Collection.

No. 8.—D. CAPENSIS (nov. spec.)

D. aeneo-nigricans, nitidus; capite sub-rugoso, utrinque profunde impresso; mandibulis, antennis pedibusque ferrugineis; prothorace globoso, laevi; elytris oblongo-ovatis, profunde punctato-striatis.

Long 3½$^{m.\ m.}$ lat. 1$^{m.\ m.}$

The head is large, somewhat rugose in the middle and with a very deep longitudinal impression on both sides; the eyes are very prominent, the antennæ, palpi, and mandibles ferruginous.

The prothorax is globose, smooth, truncated in front, and with a deep triangular impression at the apex.

The elytra are oblong, slightly attenuated and rounded at the apex, convex above, very shining, and with deeply punctured striae.

The underside is shining, brownish; the legs are ferruginous.

Captured on the Cape Flats in the month of July.

In my Collection.

Tribe: Chlænidae Lacord.

CHLAENIUS (Rhizotrachelus), Bonelli.

No. 9.—C. GIGANTEUS (nov. spec.)

C. niger, sub-nitidus, antennis nigris; capite profunde punctato; prothorace lato, medio canaliculato posticeque late impresso, rugoso-punctato, marginibus lateralibus caeruleis; elytris punctato-sulcatis, interstitiis carinulatis, laevibus, nitidis,

Long. 33m. m. lat. 12m. m.

Black, with the outer margins of the prothorax dark blue, hairless above, with the exception of the lateral margins which are slightly pubescent.

The head is large, sub-ovate, a little convex above, deeply and irregularly punctured, with a raised and nearly smooth space between the eyes; the palpi are long, cylindrical, black, and infuscated at the apex. The antennæ are black, and slightly pubescent.

The prothorax is one third broader than long, with the outer margin raised and rounded, slightly attenuated at the base which is sinuated near the lateral angles. It is black, moderately shining with the outer margin blue, almost plane above, and with large and irregular punctures. There is a deep impression in the middle of the disc, at a short distance from the apex; from that impression a broad hollow line runs down to the base, and on each side of the posterior part of the disc there is a deep impression.

The scutellum is triangular, smooth, shining.

The elytra are three times the length of the prothorax, much broader at the base, elongated, a little increased beyond the middle, strongly emarginated near the apex, slightly convex above, with deep hollow, finely punctured striæ, forming seven raised, smooth, convex lines on each elytron. The outer margin is slightly pubescent.

The underside is more shining than the upper, the abdominal segments have each a puncture on each side. The legs are black, shining; the tibiæ have strong bristles; the three basal articles of the anterior tarsi are very broad, spinose, thickly hairy underneath.

This insect, (a female specimen,) the largest, I believe, of the genus, was captured by the late Dr. Bradshaw near the Zambezi River.

In the Collection of the South African Museum.

CHLAENIUS (Rhizotrachelus).

No. 10.—C. IMMACULATUS (nov. spec.)

C. niger, sub-opacus, glaber, antennis basi flavo-testaceis, capite punctato, prothorace lato, rugoso-punctato, utrinque postice impresso; elytris punctato-sulcatis, interstitiis alternis elevatis, nitidis.

Long. 16m. m. lat. 5½m. m.

The head is moderately long, finely punctured, with a very slight impression on either side; the palpi are black, the last article very securiform; the antennae black, somewhat pubescent, and with the three first articles testaceous.

The prothorax is broader than long, with the outer margin slightly rounded at the top; it is slightly convex at the apex, plane in the middle of the disc, covered with large irregular punctures, with a deep impression on both sides of the posterior part of the disc, and with a small depressed line in the middle.

The scutellum is small, triangular, smooth, and with an impression near the base.

The Elytra are broader than the prothorax at the base, oblong, slightly enlarged and emarginated at the apex, little convex above, striated, with the interstices convex and finely punctured; the 2, 4 and 6 interstices from the suture, are very much raised, smooth and shining.

The underside is slightly punctured and shining.

Closely allied to *R. bimaculatus, Bohem*; but differs from it by the utter absence of the yellow patches on the elytra.

Captured on the Cape Flats.

In Mr. J. H. Brady's Collection.

Family: PAUSSIDÆ;

Gen. PAUSSUS, Linnæus.

No. 11.—P. CYLINDRICORNIS (nov. spec).

Plate 1. Fig 2.

P. ferrugineus, sub-depressus, pilis minutis flavis dense obsitus, antennarum articulo apicali cylindrico, longo, apice tenuiter incrassato, basi acute dentato; capite supra longitudinaliter tri-sulcato, postice retuso, medioque foveis duabus profundis munito; oculis magnis; prothorace bi-partito, parte antica elevata, postica depressa, in medio profunde sulcata; elytris sub-laevibus, pilis minutis flavis tectis; pedibus sub-cylindricis, setis flavis indutis.

Long 10m. m. lat. 3m. m.

The head has in front a very deep triangular cavity the sides of which are very acute and reach the middle of the vertex; on either side, above the eye, there is a smaller cavity, the outer margin of which extending a little before and behind the eye is much raised and forms a sort of superciliary ridge; behind the eyes, and separating the head from the neck which is very long, there is a transverse impression above which are two deep conspicuous foveae. The eyes are very large, prominent. The first article of the antennae is very massive, and deeply punctured; the punctures are filled with shining golden hairs; the second article is very long, cylindrical, slightly thickened at the apex and densely covered with short, shining hairs.

The prothorax is bi-partite; the anterior part is conical, much raised, cleft in the middle, the transverse impression very deep, and the pos-

terior part has a deep longitudinal sulcus reaching close to the base, with the lateral angles produced in a short tubercle.

The elytra are somewhat depressed, ferruginous, and darker posteriorly; they are densely covered with bright yellow hairs. The legs are compressed, and densely hairy.

Allied to *P. Schuckardi* and *P. Curtisi*, Westwood, but differs much from either species in the sculpturing of the head and thorax and by the villosity of the elytra.

From Rustenburg, Transvaal, and Vaal River, Cape Colony.

In the Collection of the South African Museum and in my own.

No. 12.—P. RUSTICUS (nov. spec).

Plate 1. Fig 3.

P. castaneo-testaceus, nitidus, tenuissime punctatus; capite tuberculo conico valido, munito; antennarum clava crassa, ovali, undique acute marginata, margine externa paullulo acuminata, leviter quadri-impressa; prothorace glabro, sub-bipartito, parte antica latiore, convexa; postica, minore, impressione transversa; elytris prothorace latioribus, rectis; pedibus glabris, coxis sub-clavatis, tibiis compressis.

Long. 9m. m. lat. 4m. m.

The head is round, the eyes very large; between them there is a long, conical. very conspicuous spine on the vertex; the club of the antennae is ovate, smooth, very thick in the middle with both inner and outer margin acute, the outer margin is slightly sinuated near the apex and has four very obsolete impressions denting the margin.

The prothorax is smooth, shining, divided in two by a transverse, median, not very deep impression; the anterior part is broader than the other, convex, smooth; the posterior part has a transverse impression in the middle.

The elytra are nearly four times the length of the prothorax and much broader. They have a slight impression on either side of the scutellary region. They are smooth, shining, and very finely punctured.

The legs are smooth, shining; the femora are sub-clavate, the tibiae compressed.

Allied to *P. spinicoxis* by the shape of the head and antennae.

From Maritzburg, Natal, and Rustenburg, Transvaal.

In my Collection.

The artist has mistaken the number of impressions on the outer margin of the clava, which should have four only and the two apical ones only distinct; the posterior part of the thorax should not have any longitudinal impression, and the transversal one should extend from one side to the other.

No. 13.—P. SIGNATIPENNIS (nov. spec.)

Pl. 1. Fig. 4.

P. testaceo-fulvus, punctatus, dense pilosus; antennarum clava valida, longa, sub-falcata, plana, apice tenuiter attenuata, postice basi acuminata; prothorace bi-partito, parte antica elevata, rotundata; postica, disco profunde bi-sulcato; elytris pilis longis griseis tectis, maculisque tribus nigris in singulo ornatis; pedibus compressis, tibiis posterioribus dilatatis.

Long. 8$^{m.\ m.}$ lat. 3$\frac{1}{2}^{m.\ m.}$

The head is plane above, slightly attenuated in front, broader behind the eyes, with the hinder margin, separated from the neck, slightly raised, and with a small longitudinal impression on the apex. It is finely punctured and slightly pilose. The eyes are not large. The first article of the antennae is massive, the second broad and elongated, slightly curved, plane above and under, with the basal outside margin produced in a long, semi-obtuse tooth; the apex is very slightly attenuated; both articles are pilose.

The prothorax is bi-partite, very pilose; the anterior part which is much raised is rounded in the middle with the angles obtusely acute; the median depression is very deep; the posterior part has two very deep impressions, and a small median groove reaching the base. The scutellum is long, shining.

The elytra are parallel, punctured, slightly convex, moderately shining, densely covered with long greyish hairs and in each are three black spots; the first one beginning at the shoulder forms a line extending to a little beyond the middle of the disc, and converging towards the suture without reaching it; below this line there is another transverse bi-lobate spot, and a third on the apical margin near the suture.

The third apical spot has been omitted in the figure by the engraver.

The legs are compressed, hairy, with the posterior tibiae much dilated.

From Potchefstroom, Transvaal. Captured by Mr. T. Ayres.

In the Collection of the South-African Museum.

No. 14.—P. AYRESI (nov. spec.)

Plate 1. Fig. 5.

P. ferrugineo-piceus, elongatus, nitidus, breviter setosus; capite rotundato, fronte cornu valido inter oculos armata, antennarum clava ovali, crassa, nigra, nitida, undique acute marginata, basi in spinam producta, disco ad marginem posticam obsoletissime quadri-impresso; prothorace bi-partito, parte antica elevata, in medio leviter bi-tuberculata, angulis lateralibus acutis; parte postica laevi, angulis exterioribus modice elevatis; elytris laevibus, nitidis, pilis brevissimis obsitis; pedibus compressis.

Long. 12m. m. lat. 5m. m.

The head is rounded, with the eyes very large, smooth, and with a long sharp spine on the vertex. The first article of the antennæ is large and compressed; the second very massive, ovale, shining, reddish-black, with the base produced posteriorly in a sharp acute spine, the exterior and anterior margins are very sharp, the former is slightly sinuated and tapers a little at the apex; the middle of the disc is not less than 2 millimètres thick, and it has four very obsolete impressions on the upper side, near the posterior margin.

The prothorax is made bi-partite by a very deep transverse impression; the anterior part is straight, slightly tuberculated in the middle, with the lateral angles acute and not much higher than the base; the angles of the posterior part, which is smooth, are slightly raised and quite as broad as the anterior angles. The head, antennæ and prothorax are reddish black. The scutellum is small, raised, and shining.

The elytra are parallel, slightly depressed, nearly four times as long as the prothorax, of a ferruginous colour, darker near the shoulders, smooth, and covered with very short greyish hairs.

The legs are compressed, smooth, and ferruginous.

Allied to *P. Procerus*, Gerstaecker, from which it differs widely by the shape of the prothorax, the massiveness of the club of the antennæ, and the presence of the cephalic horn.

Captured at Rustenburg, Transvaal, by Mr. Th. Ayres, after whom I propose to name it.

In the Collection of the South-African Museum.

No. 15.—P. NOVACULATUS (nov. spec.).

Plate 1. Fig. 6.

P. testaceus, opacus, depressus, fronte bi-carinulata; antennarum clava valida, sub-falcata, plana, margine apicali acute sinuata, apice leviter recurva, posticali ad medium canaliculata, pagina superiore leviter longitudinaliter impressa; prothorace sub-partito, parte antica elevata, postica lateribus profunde sulcatis, angulis tuberculatis, tuberculis nigris, medioque canaliculata; elytris nigris, albido setulosis, basi margineque apicali testaceis.

Long. 9m. m. lat. 3½m. m.

The head is long, attenuated at the apex, produced in a short tubercle immediately behind the eyes which are moderately large. Above, there are two raised lines acutely developed at the base, and within those ridges there is a slight impression on the vertex; the neck is short, not much narrower than the head. The first article of the antennae is small, the second one long, broad, almost plane, curved inwards, with the interior margin acute, and rounded at the apex; the outer margin is canaliculated from the base which is produced in a moderately sharp point, to two-thirds of its length. There is also

above a small longitudinal impression caused by the concavity of the outer marginal groove. The clava might be compared to the blade of a razor, the upper part of which would be slightly curved. The head and antennae are testaceous, and finely punctured.

The prothorax is testaceous, covered with minute greyish hairs, sub-ovate, truncated, broader than the head and bi-partite; the median part which is deeply sulcated on each side, has a deep impression in the centre; the posterior part is narrower than the anterior, with the lateral angles tuberculated and black.

The elytra are parallel, depressed, black, with the base and apical margin from (and including) the callus to the suture testaceous, and covered with greyish hairs.

From Vaal River, Cape Colony. Captured by Mr. T. Ayres.

In the Collection of the South-African Museum.

Family: HISTEROIDINI;

Tribe: Saprinidae, Lacord.

Genus SAPRINUS, Erichson.

No. 16.—S. FLAVIPENNIS (nov. spec).

S. niger, viridescens, fronte rugosa, triangulariter producta; prothorace punctulato, lateribus rugulosis, apice utrinque impresso; elytris punctulatis, flavidis, stria suturali fere integra, striis quinque discoidalibus abbreviatis insculptis; marginibus infuscatis plagisque duabus prope suturam nigris.

Long. 7$^{m.\ m.}$ lat. 4½$^{m.\ m.}$

Ovate, convex, shining in the middle, sub-opaque in the sides. The antennæ are black, the knob, rufous. The head is rugose, with a deep impression on either side, forming a triangular raised line.

The prothorax is broader than long, greenish black, bi-sinuated at the base, very rugose on the lateral and apical sides, shining in the disc, almost smooth at the base, and with an impression on each side. The scutellum is small, triangular.

The elytra are longer than the prothorax, slightly increased at the shoulders, attenuated and abruptly truncated at the apex, finely punctured, very shining in the anterior and median part of disc; they are yellow, slightly reddish, with the margins and suture infuscated. The infuscation on the suture forms one transverse patch immediately

under the scutellum, reaching the first stria, and a second one somewhat larger than the first, a little lower down. The first and second dorsal striae are longer than the third and fourth, the latter does not reach the base; the humeral is slightly curved inwards; the subhumeral is very small; the marginal is entire; the sutural does not reach the base.

The pygidium is deeply punctured, and greenish black. The legs are brown, semi transparent, the anterior tibiae have seven denticulations.

From Damaraland.

In my Collection.

Family: TROGOSITIDÆ.

Genus ALINDRIA, Erichs.

No. 17.—A. AUSTRALIS (nov. spec.)

A. fusco-nigra, nitida, prothorace concinne punctato, impressione longitudinali lacvi in medio notato; elytris cylindricis, postice rotundatis, punctatis.

Long. 22-30 m. m. lat. 8-9m. m.

Resembles very much *A. elongata*, Guérin, but the mandibles are more acutely toothed, the impression in the middle of the head is smooth, the prothorax is much more finely punctured, and in the centre of the disc there is a smooth, faint, longitudinal impression which does not however reach either the apex or the base; the punctures of the elytra are much smaller and the three first discoidal costae between the double rows of punctures are almost obsolete.

From Knysna and Kowie, Cape Colony and Rustenberg, Transvaal.

In my Collection.

Family: COLYDII.

Tribe: Synchitidæ, Lacord.

Genus COSSYPHODES, Westwood.

No. 18.—C. WOODROOFFEI (nov. spec.).

C. sub-ellipticus, valde convexus, ferrugineus, sub-nitidus; capite semicirculari, limbo plano, antice leviter recurvo, supra punctatissimo, in medio lineis quatuor elevatis, scilicet: utroque lateri una recta, alteraque oblique

supra oculos posita; oculis distinctis, nigris; prothorace transverso, convexissimo, dense aciculato, lineis sex serratis instructo, margine lata, dentibusque novem acutis armata; elytris convexis, prothorace dimidio longioribus, postice acuminatis, lineis elevatis sex in singulo instructis, secunda a sutura quartaque magis elevatis, hac spina acuta apicali; margine laterali lata, et sutura in spinam producta.

Long. 2m. m. lat. 1m. m.

Sub-elliptic, very convex, reddish brown. The head is semi-circular, finely punctured, with the clypeus slightly recurved; on each side of the head are two raised rugged lines, one straight, reaching the middle, the other runs a little obliquely and forms a kind of ridge above the eye. The eyes are apparent, and black.

The prothorax is very convex, almost triangular above, slightly longer than broad, and with the apical angles rounded. It is strongly aciculated, and has six serrated raised lines; the lateral margin is broad and the edge has nine sharp teeth on each side.

The elytra are very convex, once and a half as long as the prothorax, not broader at the base, but ampliated in the middle, from which part they become acuminated, and with an apical spine near the suture. Each elytron has six elevated lines disposed as follow:—the first one, near the suture is small and coalesces with the second which is very much raised and ends in an obtuse tooth; below it, the third line, also small, coalesces with the fourth which is the most raised of all and ends near the apex in a conspicuous somewhat blunted tooth. The other two raised lines are small.

Allied to *C. Wollastoni*, Westwood, but much more triangular on the upper side.

Captured in the month of July by my young friend Mr. Woodrooffe, after whom I propose to name this interesting insect.

This Cossyphodes is the second species of that Genus found in South Africa, the first being the *C. Bewicki* described by Wollaston. Three more species are recorded from Abyssinia.

These insects seem to be myrmecophile. I have not been able to ascertain whether Mr. Woodroffe has met the two specimens he sent me living among ants, but I deem it probable, because I had asked him to look especially for *Paussi* among ants nests.

I have captured the *C. Berwicki* in great number in the Hex River Mountains, 3000 feet above sea level, in the month of June. I found them in the nests of an ant of the genus "*Plagiolepis*." When touched, they throw back their thorax almost at right angle with the elytra. They are very nimble, and did not seem to be at all paralysed by the cold, while the ants were benumbed. I found them adhering to the stones, or running freely among the ants when the heat of the sun had freed the latter from their torpid state.

Family : DERMESTINI.

Gen. ATTAGENUS, Latreille.

No. 19.—A. LAETUS (nov. spec.)

Long 5m. m. lat. 3m. m.

A. niger, pube densa supra nigra, subtus grisea vestitus; prothorace flavo variegato, elytris fasciis duabus transversis flavis.

The head is small, covered with short greyish hairs; the antennae are reddish, the clava infuscated.

The prothorax is covered with a short, black, silky, pubescence; on the outer margin there is a patch of bright yellow hairs, broadening near the base, two spots of the same hue on the disc, a little beyond the middle, and another immediately above the scutellum.

The elytra are three times the length of the prothorax, straight, rounded at the apex, moderately convex above, covered with a short, black, silky pubescence, and with two transverse golden-yellow bands; the anterior one is bi-sinuated, and begins near the scutellum; the posterior is placed beyond the middle of the disc, and does not reach the suture.

The underside and legs are covered with a greyish, silky pubescence; the tarsi are slightly ferruginous.

Captured at Koeberg, Cape Colony.

In my Collection.

No. 20.—A. JUCUNDUS, (nov. spec.)

A. fuscus, pube dense flavo-grisea tectus; prothorace maculis parvis quatuor denudatis; elytris macula rotundata sub-humerali fasciisque duabus denudatis.

Long. 4-4½m. m. lat. 2-3m. m.

The head is small, slightly pubescent, the antennae reddish.

The prothorax is covered with dense greyish hairs, and has four denuded spots on the disc, one on each side, small, the other two, larger, in the middle.

The elytra are three times the length of the prothorax, not broader at the base, straight, rounded behind, very slightly convex above; a little below the base, there is a denuded round spot, varying in size in several specimens, a transverse sinuate denuded band in the middle and a second one lower down which reaches the apex.

The underside is silky, pubescent; the legs are pale brown.

From the Vaal River near Kimberley, Cape Colony, and also from Rustenburg, Transvaal.

In my Collection.

No. 21.—A. FLORALIS (nov. spec.)

A. niger, pube densa supra nigra, subtus, grisea vestitus; prothorace flavo-variegato; elytris fasciis duabus maculaque apicali pallide fulvis.

Long. $4\frac{1}{2}$ m. m. lat. $2\frac{1}{2}$ m. m.

Resembles much the *A. jucundus*. The prothorax is covered with black hairs, and has four indistinct pale-yellow spots along the base.

The elytra are three times the length of the prothorax, not broader, moderately convex above, and with two transverse bands and an apical spot of pale-yellow hairs.

The first band begins at the base, is interrupted near the shoulders and also in the disc where two black spots are discernible, and does not quite reach the middle of the disc; the second one is narrow, slightly sinuated and placed a little beyond the middle.

The underside and legs are clothed with a greyish pubescence.

Captured at Camp's Bay, near Cape Town.

In my Collection.

Family: LAMELLICORNIA.

Group: Copridae, Lacord.

Gen. COPRIS, Geoffroy.

No. 22.—C. CURVIFRONS (nov. spec.).

C. convexa, fusco-nigra, nitida; capite tenuiter punctato, margine apicali in dentibus duabus elevatis leviter recurvis reflexa; prothorace punctato, antice truncato, parte antica nitida, utrinque profunde impressa, parte postica gibbosa, in medio tenuiter emarginata, utrinque obtuse bi-tuberculata.

Long. 11 m. m. lat. 6 m.

The head is broader than it is long, convex above, blackish, shining, with a smooth ridge extending from eye to eye; the clypeus is rounded, slightly marginated and produced in the middle in two semi-long teeth, diverging slightly at the apex and a little curved inward. The antennæ are of a light-ferruginous colour.

The prothorax, as broad as long, is slightly rounded at the sides and at the base, cut abruptly and deeply impressed in front on the sides. The disc of the prothorax, which is very raised, is produced in two bituberculated gibbosities, slightly overhanging the apical declivity. It is finely punctured on the dorsal disc, and almost smooth in front.

The elytra are not much narrower than the prothorax at the base, convex, fuscous, shining, very finely striated with the intervals between the striæ finely and densely punctured. The under side is reddish brown, finely punctured, smooth, with only a little fulvous villosity in the anterior part of the first coxæ. The legs are reddish-brown, shining, slightly pilose, with the anterior tibiæ quadri-dentate; the basal tooth is sub-obsolete.

From the Limpopo River.

In the Collection of the South-African Museum.

Group: Onthophagidæ, Lacord.

Gen. ONTHOPHAGUS, Latreille.

No. 23.—O. BRADSHAWI (nov. spec.)

O. aurato cupreus; capite (in mare) cornubus duobus in medio ramo parvo instructis, ad apicem acutis, armato; prothorace antice quadri-tuberculato, medio canaliculato; elytris pilis albidis adspersis.

Femina a mare differt capite vertice tri-tuberculato, prothoraceque granulato.

Long 10-11$^{m.\ m.}$ lat. 7-7½$^{m.\ m.}$

Bright metallic golden-red. The clypeus of the male is divided in two by a transverse ridge, and covered with silky white hairs. From that ridge rise two crescent-shaped horns, one-third shorter than the prothorax, with a small internal ramus towards the middle. They are slightly flattened inward, rounded outward and pointed at the top. A small conical tubercle is noticeable on the apex of the head, in the centre of the horns.

The finely punctured prothorax is convex, broader in the centre, canaliculated in the middle, with two tubercles on each side of the median depression. On each side of the disc, close to the outer margin there is a greenish slightly raised tubercle.

The elytra which are slightly tuberculated, are broader than the base of the prothorax, covered with short whitish hairs and provided with a humeral callus; the suture is very shining. The pygidium is covered with long silky white hairs. The underside and legs are green. On each side of the pectus is a bunch of white hairs.

The female differs from the male by the absence of horns, the rudiments of which are, however, discernible in the shape of a semicircular ridge indented in the centre. The prothorax is slightly raised at the apex, canaliculated, and more closely punctured than in the male. The humeral callus is also rudimentary.

The colour of this species is the same as in *O. rangifer*, Klug; although perhaps slightly less brilliant. It differs from *rangifer* in the shape of the horns which are much shorter, the internal ramus is less conspicuous, and the tips are pointed instead of being flattened. The humeral callus is neither so much raised, nor so much curved, and the general size is about half that of *rangifer*.

The female is very much like that of the above named species, but the apical elevation of the prothorax and also the humeral callus are less conspicuous.

I propose to name that insect after the late Dr. Bradshaw, who captured several specimens on the Zambezi River.

In the Collection of the South-African Museum.

Tribe: Aphodiidæ, Latord.

Gen. APHODIUS, Illiger.

No. 24.—A. NIGRO-SIGNATUS (nov. spec).

A. oblongus, modice convexus, flavus, nitidus; capite mutico, ante medium macula magna nigra notato; prothorace convexo, laevi, medio tenuiter impresso; utrinque bimaculato, maculis nigris, anteriore minore; elytris concinne punctato-striatis, pone humeros macula parva, rotunda, in singulo posticeque fascia communi lata nigris notatis.

Long. 11$^{m.\ m.}$ lat. 6$^{m.\ m.}$

The head is broader than long, a little convex above, smooth, marginated, slightly truncated at the apex and with a triangular black spot in the middle. The antennae are pale-yellow, the clava infuscated.

The prothorax is yellow, smooth, shining, twice as broad as long, convex above, sinuated at the base, marginated on the sides, with a faint longitudinal impression in the middle, and two rounded black patches on each side of the disc, the anterior one-half the size of the posterior. The scutellum is triangular and smooth.

The elytra are truncated and not broader than the prothorax at the base, slightly attenuated at the apex, convex and finely striated above: the striae are punctured and the interstices smooth and shining. Close to each shoulder there is a small, rounded, black patch, and the whole of the posterior half of the disc is filled with a black patch slightly sinuated anteriorly.

The underside is pale-shining-yellow; the legs are of the same colour, slightly infuscated at the knees, and the anterior tibiae are tri-dentate.

From the Zambezi River and Delagoa Bay.

Allied to *A. Wahlbergi*. Bohem. The colouring of the elytra and the spots on the head and prothorax are nearly the same, but it differs from the latter in having a humeral black spot wanting in *A. Wahlbergi*, and also by the shape of the apical patch.

In the Collection of the South-African Museum and in my own.

Sub-Family: MELOLONTHIDÆ.

Sub-Tribe: Hoplidae, Lacord.

Gen. LEPITRIX, Serville.

No. 25.—L. HIRTIPES (nov. spec.)

L. breviter ovata, supra parum convexa, prothorace tenuiter rugoso-punctato, hirto, setosis nigris, punctoque marginali albido utrinque notato: elytris triangulis, nigris, hirtis, squamis albidis tectis; pygidio albo, tibiis tarsisque posticis, articulo ultimo excepto, valde hirsutis.

Long. 6·7m. m. lat. 4·5m. m.

Male.

Black, hairy and squamose. The clypeus is strongly acuminated, curved upwards at the tip. The prothorax is finely punctured, convex and densely covered with long upright hairs. In the centre of the outer margin, there is a scaly white spot, and also a few faint white squamosities in the basal margin. The scutellum is also squamose.

The elytra are triangular, deeply depressed transverely below the scutellum, and broader than the prothorax. They are covered with scattered bristles longer and more conspicuous near the suture; under those hairs some white scales form one transverse line immediately below the scutellum, and another lower down. From that second line

the white scales follow the suture, round the apex, where they are most distinct, and ascend the outer margins where they form a very faint white line which reaches the shoulders. The pygidium is covered with silvery-white scales, interspersed with erect hairs, some of them forming a regular row at the top. The abdominal segments are pure white, and the pectus is covered with a greyish-white, soft down. The hind legs and tarsi are bristling with dense long black hairs, giving the insect a most singular appearance.

Female.

The female is much like the male but less hairy and with the scales less noticeable. The hind legs and tarsi are also hirsute, but in a lesser degree.

I believe this insect to be identical with the Lepitrix mentioned in Lacordaire's *Genera des Coléoptères*, vol. 3, p. 181.

It somewhat resembles the *L. bilateralis* in shape, but it is easily distinguished from the latter, firstly by the form of the elypeus, and secondly by the hirsute legs.

From Spectakel and Cograbies, Namaqualand, where they were captured by Mr. R. Trimen.

In the Collection of the South-African Museum.

Gen. MONOCHELUS, Serville.

No. 26.—M. NATALENSIS (nov. spec.).

M. ovatus, modice convexus; clypeo breviter reflexo, a capite linea transversali interrupto; antennarum clava nigra; prothorace convexo, nigro, squamulis aurantiacis obsito; elytris, pedibus tarsisque rubris, nitidis, squamulis parvis albidis ornatis; pygidio nigro, vix denudato, squamulis aurantiacis obsito; tarsis posterioribus dente simplice arcuato armatis.

Long. 10$^{m.\ m.}$ lat. 6$^{m.\ m.}$

Male.

Head small, black, covered with yellow scales, separated from the clypeus by a deep transverse line; the clypeus is slightly turned upward and rounded.

The prothorax is convex, covered with scales, with a nude space forming two parallel lines in the centre; the apical and lateral margins with long, stiff, golden hairs. The scutellum is densely covered with yellow scales.

The elytra are smooth, red, slightly convex, broader than the prothorax, with the humeral angles strongly developed, and with two faint raised lines on each elytron; here and there are scattered a few small white scales, more abundant in some specimens than in others. The pygidium is black, and dotted with yellow scales.

The legs are red, the fore tibiæ tridentate; the basal tooth is the smallest; the posterior femora are very thick, large, rounded exter-

nally with a strong spine at the base; the tibiae are armed at the apex with a strong spine directed inward; the claw of the tarsi is long, curved, and simple. Both femora and tibiae are covered with hairs and scaleless. The ventral segments are coated with yellow scales, as well as the upper part of the pectus.

Female.

The female much resembles the male, but is more parallel; the scales on the elytra and ventral segments are denser; the legs are small, and without traces of spines on the posterior ones.

This insect, I am told by one of my Paris correspondents, although not described, is known there by the name of M. calcaratus. I have not adopted the name, because there is already a *M. calcaratus*, Burm., which, although allied, is very different from the present one.

From Maritzburg, Natal, and Leydenburg, Transvaal.

In the Collection of the South-African Museum and in my own.

No. 27.—M. (Heterochelus), PULCHER (nov. spec.)

M. breviter ovatus, convexus, nitidus, squamis aurantiacis dense obsitus; antennarum basi pedibusque rufo-ferrugineis; tarsis nigris, posterioribus ungula bi-dentata armatis; elytris cupreis.

Long. 7m.m. lat. 5m.m.

Male.

Head small, clypeus slightly reflexed, and rounded. The prothorax is convex, covered as well as the head with closely packed golden scales, leaving two parallel lines in the middle of the disc and one on each side denuded; the apical and lateral margins have very long stiff hairs; the scutellum is covered with minute closely set scales. The elytra are broader than the prothorax, of a rich metallic bronze, and densely covered with golden scales. The pygdium, ventral segments and pectus are also covered with yellow scales. The legs are red with the tarsi black. The fore tibiae are bi-dentate; the posterior femora are thick, rounded externally and with a strong conical spine towards the apex; the apical part of the tibiae is curved inward, and forms a strong spine; the claw, long and curved, has a small obtuse tooth at the base, as in *M. calcaratus*.

Female.

The *female* is very much like the male, but is more parallel; the legs are normal, the posterior femoral spine is wanting and the apex of the tibiae is less curved. The scales are also more numerous on the underside. I believe that the male loses some of the pectoral scales through the process of copulation.

From Rustenburg, Transvaal.

In the Collection of the South-African Museum and in my own.

Gen : GYMNOLOMA, Burmeister.

No. 28.—G. FESTIVA (nov. spec.)

G. ovata, postice attenuata, nigra, squamis albido-flavidis adspersa; clypeo acuminato, lateribus in dentem productis; prothorace convexo, piloso, marginibus squamis flavidis vel argenteis tectis; elytris fulvo-testaceis, pilosis, sutura squamis argenteis dense obsita; pygidio flavo-squamoso.

Mas. Long. 8·10$^{m.m.}$ lat. 5·6$^{m.m.}$

Fem. Long. 8$^{m.m.}$ lat. 4$^{m.m.}$

Male.—The head is black, slightly hairy with the clypeus long, and acuminated. The outer sides are produced in a tooth curving outward.

The prothorax is transverse, slightly attenuated at the apex, sinuated at the base, slightly punctured above and with a faint median longitudinal impression. It is densely covered with yellow hairs, longer near the margins, which at the base and on the sides are coated with yellowish-white scales, turning to a silvery-blue in some specimens. The scutellum is very long, pointed, and scaly.

The elytra are much broader than the prothorax, rounded at the shoulders, strongly attenuated at the apex, almost plane in the middle of the disc, and with a lateral impression on each side beginning at the shoulders, but not reaching the apex. They are of a brick-red colour, somewhat shining and covered with short, pale hairs. The suture has on either side a broad band of yellowish-white glittering squamae, which turn into coeruleus-blue in some specimens. The pygidium and abdomen are covered with yellowish-white scales; the pectus has pale-yellow hairs. The fore-legs are bi-dentate and reddish, with the outer part of the tibiae of the second pair very scaly; the posterior pair is very strong, long and fuscous-black, with the outer part of both femora and tibiae scaly; the hind tarsi are very massive.

The shape of the posterior legs is exactly like those of a *Scelophysa*.

Female.—Smaller than the male. The prothorax is more scaly and the hairs are less dense. The angles of the clypeus are less sharp, the rich fulvous colour of the elytra is of a paler hue. The anterior legs are tri-dentate; the posterior are normal, and all of them are reddish and scaly.

This species seems to form a link between the genera *Gymnoloma* and *Scelophysa*.

From Rustenberg, Transvaal and Vaal River, Cape Colony.

Gen: SCELOPHYSA, Burmeister.

No. 29.—S. TRIMENI.

Mas. S. nigra, omnino squamis caeruleis tecta; elytris rufescentibus, capite pedibusque piceis, his nitidis.

Femina. Supra galbana, subtus albida.

Long. 10-12$^{m.m.}$, lat. 5-6$^{m.m.}$

Male.—Head black, punctured, covered with brownish hairs; the prothorax is convex, coated with light-blue scales and dotted all over with brownish hairs, longer and bristly all round the margins. The elytra are oblong and attenuated towards the apex; they are of a light-chocolate colour, densely covered with blue scales and with faint rows of hair which are more conspicuous near the suture and developed into long bristles along the outer margins. The scutellum, pygidium, ventral segments and underside of the thorax are also covered with closely set scales of a lighter and more glittering blue than those of the upper part of the body. The pectus is slightly hairy. The femora and tibiae have a few bristles; the posterior ones are dotted with scales, more numerous on the outer part.

Variety A. The scales are less numerous, yet dense near the outer margins.

Variety B. The scales are almost absent, showing the elytra brown with a faint blueish tinge.

Female.—The female has the general facies of the male, although it is more convex and robust. The head is black, hairy; the prothorax, scutellum, elytra and pygidium are covered with yellow, very slightly greenish scales, turning into yellowish-white on the underside. The hind legs are red, less thick than the male's, and have a few white scales more numerous on the outer part.

This lovely beetle inhabits Namaqualand. Both sexes of the typical forms were captured *in copulâ* near Spectakel, in the month of August, by Mr. R. Trimen after whom I propose to name it. Had they not been found together, it would be difficult to believe that they belonged to the same species.

The varieties A and B which are far less brilliant than the typical form, were captured at Port Nolloth.

In the Collection of the South-African Museum.

Tribe: Cetonidæ, Lacord.

Gen ISCHNOSTOMA, Gory. and Perch.

No. 30.—I. PICTA (nov. spec.)

Pl. 1. Fig. 7.

I. nigra, supra convexa, clypeo parallelo, hirto, apice lateraliterque reflexo; antennis rubris; prothorace rubro, hirto, apice tuberculato; elytris rubris, foveolato-crosis, fasciis duabus ornatis; pygidio maculis binis albidis; tibiis anticis unidentatis.

Long. 18m.m. lat. 9m.m.

Black, convex above. The clava of the antennae is long, yellow, the first article black. The elypeus is elongated, nearly straight, longer than the head, turned up at the apex and also on the outer margins, and covered like the head with long decumbent hairs.

The prothorax is very convex, pilose, rounded in the upper angles, and has a small tubercle in the middle of the apical margin. It is of a light opaque red, deeply punctured and covered with short greyish hairs. There is in the middle a somewhat indistinct black patch, which, in some specimens changes in two spots placed above the scutellum. The lateral margins are faintly coated with white. The scutellum is red, with the sides blackish.

The elytra are reddish, hairless, punctured, and with two slightly raised line on each elytron. The outer line is very faint and hardly reaches the middle. Below the scutellum, beginning from the second line and reaching the suture, there is a transverse black sinuated band and another under it which begins from the outer margin and runs parallel to the suture without reaching it.

The pygidium is black, with two large white spots. The underside is black and shining; the pectus covered with grey hairs. The legs are black, shining; the fore tibiae uni-dentate and slightly hirtose; the tarsi are very short.

Variety A. In this variety, the indistinct black patch of the prothorax has invaded the whole disc, leaving only two ferruginous spots in the outer margins; the first transverse band of the elytra begins near the scutellum and covers it; the second one reaches the suture. The pygidium and legs are red.

Variety. *limbata.* Facies of the type form, but opaque black; the head and clypeus are covered with grey hairs; the prothorax is black with white outer margins; the elytra and pygidium are black; the latter has two white conspicuous spots.

After careful examination, I have been unable to separate the variety *limbata* from the typical form, although the colouring is very different. But the sculpturing of the teguments is exactly the same, and the variety A seems to be a form of transition. The variety *limbata* is also slightly smaller, and the difference of colour may be due to sexual differences, in which case this variety should become the type form.

The three varieties (12 of them) were sent to me at the same time from Rustenberg, Transvaal.

In the Collection of the South-African Museum, and in my own.

No. 31.—I. ALBO-NOTATA (nov. spec.)

I. nigra, sub-opaca, modice convexa; antennarum clava maxima, nigra, nitida; clypeo elongato, fere parallelo, antice leviter recurvo; prothorace foveolato, lituris novem albidis notato; elytris fere planis, elongatis, nigris, in singulo tricostatis, limbo externo maculaque prope apicem suturæ utrinque albidis; pygidio bi-maculato.

Long. 21m.m., lat. 11m.m.

Black, semi-opaque; clypeus longer than the head, almost straight, deeply punctured, slightly curved at the tip, and with a few bristles near the junction with the head. Antennæ black, shining, palpi reddish. No spine above the eyes.

The prothorax is convex, rounded in front, with the basal angles nearly reaching the humeral base of the elytra, deeply punctured and with a smooth, shining, and slightly raised line in the middle and with nine white marks disposed as follows: one on each side of the apex, immediately behind the eyes; two in the shape of a coma, along the median line; two on each side of the base, and one in the middle, immediately above the scutellum.

The scutellum is long, pointed, and with a shining, slightly raised line in the centre.

The elytra are almost plane and parallel, slightly punctured, each with three raised shining costæ; the median one does not reach the apex. The suture is shining, raised, and has two white apical spots on each side. The outer margins are thickly coated with a white pigment. The pygidium is black, and has two large white spots. The pectus is slightly hairy, the legs, which are deeply punctured, are black, and dotted with a few bristles; the fore tibiæ are bi-dentate and the basal tooth very small; the tarsi are long and hirtose.

One specimen (male ?) in the Collection of the South-African Museum. From Leydenburg, Transvaal.

Group: True CETONIDAE, Lacord.

Gen: CETONIA (Trichostetha) Fabricius.

No. 32.—C. PLACIDA. Bohem. Insecta Caffr. v. 2, p. 20.

Variety: *algoensis*.

Long. 17-19m.m., lat. 7-9m.m.

Size of the typical form. The prothorax is dark-green, glossy in some specimens, opaque in others, with a small reddish spot on either side in the basal external angle. The scutellum is black, shining. The two black spots on the elytra of the type have invaded the whole disc, leaving only a narrow margin of pale-fulvous-yellow in one specimen. In two other specimens, the infuscation is limited to the sutural part, runs outside the costae, and hides the outer spot.

The elytra of a fourth specimen are nearer those of the type, but the inner spot is reduced to a mere speckle, and the apical line, where the costae meet, is infuscated.

Were it not for the latter intermediate form, I should have been inclined to consider the variety *algoensis* as a new species.

From Delagoa-Bay.

In the Collection of the South-African Museum.

Group: CREMASTOCHILIDÆ, Lacord.

Gen.: PTYCHOPHORUS, Schaum.

No. 33.—P. RUBRONOTATUS (nov. spec.)

P. oblongo ovatus, niger, sub-nitidus; antennis flavis; prothorace aciculato, basi utrinque impresso, maculis duabus parvis opalinis; elytris vage punctatis, singulo unicostato, ad suturam bi-striato, disco bi-impresso, plagis duabus rubris notato, margine apicali pygidioque albido-maculatis.

Long. 8$^{m.m.}$ lat. 4$^{m.m.}$

Head black, punctured; antennae yellow. The prothorax is black, convex, covered with transverse flexuose lines, and with two deep oblong impressions at the base; on each side of the impression there is a small opaline spot reaching the basal angle. The scutellum is long, triangular and aciculated.

The elytra are slightly broader than the prothorax, twice as long, strongly sinuated near the humerus, rounded at the humeral angles, slightly convex and attenuated near the apex. They have a few squamiform hairs disposed in series, probably more abundant in other specimens. Along the suture are two small raised lines and also a large costa on each elytron; the disc has two deep impressions, one near the humeral part, the other a little below the middle; there is a shining semi-quadrangular red patch extending between the two impressions, and another, smaller than the first, under the second impression. The apical margin is dotted with a few yellowish-white spots, likewise the pygidium.

The underside is black, shining.

From Delagoa-Bay.

In my Collection.

Sub-Family: Trichidæ, Lacord.

Gen.: AGENIUS, Serville.

No. 34.—A. GRANDIS (nov. spec.)

A. elongatus, niger, opacus, supra leviter convexus; antennis nigris, palpis infuscatis; clypeo elongato, apice sub-acuto, creberrime punctato; prothorace elytrisque nigris, his vitta longitudinali, lata, aurato-cuprea ornatis; subtus nitidus, parce setulosus.

Long. 18m.m., lat. 8m.m.

Elongated, black, opaque above. The clypeus is long, acuminated, closely punctured like the head and prothorax. The latter is convex, with the apical angles rounded, impressed in the middle, the impression deeper near the base. The scutellum is black.

The elytra are black, opaque, twice the length of the prothorax, almost plane above, attenuated and rounded near the apex of the suture where they do not join. At a little distance from the outer margin and beginning at the humeral angle, there is a broad longitudinal line of a shining coppery-red hue.

The underside is pitchy-black, moderately dotted with a few long greyish hairs. The legs are long, black, dotted with black bristles.

From Springbokfontein, Namaqualand.

In the collection of the South-African Museum.

No. 35.—A. NAMAQUENSIS, (nov. spec.)

A. niger, ovatus, supra fere planus; antennis longis, nigris; clypeo elongato, quadrato, capite hirto; prothorace nigro; elytris punctulatis, testaceis, nitidis, marginibus suturaque nigris.

Long. 13m.m., lat. 8m.m.

General facies of the *A. limbatus*. Black, palpi reddish. The clypeus is long, nearly parallel, curved at the apex; the head is covered with long greyish hairs.

The prothorax is black, closely punctured and covered with long greyish hairs. The scutellum is black.

The elytra are pale-yellow, smooth, shining, slightly attenuated towards the apex. The suture, apical and lateral margins are black. The pygidium and underside are also black and the latter covered with long greyish hairs; legs long, black.

Captured in the month of August, at Ovgrabie, Namaqualand, by Mr. R. Trimen.

In the Collection of the South-African Museum.

No. 36.—A. PLAGOSUS, (nov. spec.).

A. niger, ovatus, modice convexus, glaber; antennis flavis, articulo basali nigro; elytris flavis, nitidis, plaga communi magna triangulari, nigra, suturæ apicem attingente, lateribus nigris.

Long. 12m.m. lat. 7m.m.

Black, shining, slightly convex. The antennæ with the exception of the first article are yellow. The clypeus is short, rounded at the apex, not longer than the head from which it is separated by a deep impression.

The prothorax is convex, black, shining, broader in the middle, hairless, and closely punctured. The scutellum is black, punctured.

The elytra are slightly convex, golden-yellow, smooth, shining, attenuated in the apex, more than in *A. limbatus*. In the middle there is a triangular black patch with the point reaching the apex of the suture. There is a small black line on the outer sides and also on the apical margins.

The underside and pygidium are black, shining. The legs are black, long, shining and dotted with a few bristles.

From Leydenburg, Transvaal.

In the Collection of the South-African Museum.

Family: BUPRESTIDAE

Tribe: Julodidae, Lacord.

Gen.: JULODIS, Eschscholtz.

No. 37.—J. GARIEPINA.

Pl. 1. fig. 8.

T. oblonga, convexa, cuprea, sub-nitida; prothorace elytrisque punctatis; illo vittis quinque, his vittis quatuor in singulo sulphureo-lanuginosis ornatis; subtus albido pilosa.

Long. 33m.m. lat. 15m.m.

Oblong, convex, coppery metallic-blue. The head is rounded, convex, flat on the vertex, deeply punctured and with a few pallid hairs. The antennae are black, the serration silky.

The prothorax is short, narrowed in front, deeply punctured, with five longitudinal impressions filled with long hairs and covered with a sulphur-yellow substance.

The elytra are four times the length of the prothorax, not broader at the base and much attenuated towards the apex, deeply punctured and with four longitudinal impressions on each elytron filled with long hairs covered with a sulphur-yellow pollinosity; the third line from the suture coalesces with the fourth before reaching the apex. The outer margin is dotted with short tufts of reddish hairs.

The under-side is coarsely punctured and densely covered with very long silky hairs, which are longer on the sides of the abdomen. On the pectus, above the posterior coxae and also on each side of the abdominal segments, there is a small tuft of sulphur-yellow hair.

This splendid insect was captured at Kakamas near the Orange River, Cape Colony, by the late Dr. Bradshaw.

In the collection of the South-African Museum and in my own.

Family: MALACODERMIDÆ;

Tribe: Drilidæ, Lacord.

Gen.: SELASIA, de Castelnau.

No. 38.—S. PALLIDA (nov. spec.)

S. tota fulva, pubescens, punctato-striata, mandibulis apice oculisque nigris.

Long. 9-12$^{m.m.}$ lat. 4-5$^{m.m.}$

Fulvous, covered with a yellowish down. The antennae are as long as the head and prothorax. The head is transverse, shining, with a deep impression between the antennae. The eyes are large, rounded, black.

The prothorax is a little broader than long, slightly convex above and with two small depressions in the centre of the disc; it is covered, like the head, with a pale yellow down; the posterior angles are very acute. The scutellum is triangular.

The elytra are a little broader than the prothorax, finely striated, and densely covered with yellowish hairs; the humeral angles are strongly developed. They are semi-transparent, and the under-wings infuscated at the apex.

The under part of the body and the legs are fulvous; the pectus, abdomen and legs are covered with yellowish hairs.

Closely allied to *S. rhipiceroides*, but differs from it by the colouring of the elytra and the striation.

From Delagoa-Bay.

In the Collection of the South-African Museum and in my own.

Tribe: Melyridæ, Lacord.

Gen.: MELYRIS, Fabricius.

No. 39.—M. LIMBATA (nov spec.)

M. oblongo-ovata, convexa, viridi-aenea, sub-nitida, glabra; antennis palpisque nigris; prothorace punctato, utrinque marginato; elytris sex-costatis, interstitiis profunde seriatim punctatis, limbo externo rubro, nitido.

Long. 4-5$^{m.m.}$ lat. 1½-2$^{m.m.}$

Coppery green, convex, parallel. The antennae and palpi are black. The eyes, also black, are finely granulated; the head and prothorax are deeply punctured, the latter very convex, deeply marginated, with the apical and lateral margins serrated. The apical margin has five sharp teeth. The scutellum is truncated.

The elytra are three times the length of the prothorax. On each elytron are three ridges, each interstice filled with three rows of deep punctures. The outer margins are red. The legs are dark-green, the femora and tibiae are dotted with short whitish hairs, the tarsi and claws are reddish. The underside is of a very dark green, the interior of the margins red. When seen from under, the insect seems serrated through short bristles extending all round the prothorax and elytra.

Allied to *M. lineata* Fabric.

From Knysna, Cape Colony.

In my Collection.

Family: TENEBRIONIDÆ:

Tribe: Adesmiidæ, Lacord.

Gen.: ADESMIA, Fisher.

No. 40.—A. ANDERSONI (nov. spec.)

A. nigra, nitida, oblongo-ovata, laevi, capite plicato, in medio impresso; prothorace transverso, supra convexo, utrinque carinato, lateribus antice valde productis, margine apicali pilis brevis aurantiacis obsita; elytris elongatis, sub-ovatis, supra convexissimis, apice dehiscentibus, sutura apicali lineisque posticis tribus elevatis; pedibus longissimis.

Long. 18-20m.m. lat. 8-10m.m.

The head is large, plicated, narrowed in front, depressed above, with a round impression in the middle and a longitudinal ridge above each eye.

The prothorax is transverse, finely punctured, strongly sinuated at the apex, with the lateral angles very acute, convex above, smooth, with a faint longitudinal impression in the middle; the lateral and apical margins are carinated, the latter has a fringe of short, silky, golden-yellow hairs.

The elytra are elongated, much in the shape of the *A candidipennis*, three times the length of the prothorax, not broader at the base, slightly enlarged in the middle, tapering behind, very convex above and declivous towards the apex. They are quite smooth, shining, with the suture and three lines on each elytron suddenly raised in the posterior declivity. The raised lines are obsoletely serrated.

The underside is black, shining, coarsely plicated longitudinally; the cotyloid cavities are fringed with golden hairs. The legs are very long, the posterior femora are grooved underneath, and twice the length of the abdomen. The tibiae are faintly serrated, the spurs are extremely long and red, like the claws which are also very much developed. The basal article of the posterior tarsi is shorter than the apical.

From Damaraland, where it was captured by the late Mr. Anderson, after whom I propose to name it.

In the Collection of the South-African Museum and in my own.

No. 41.—A. NAMAQUENSIS (nov. spec).

A. elongata, nigra, sub-nitida, retrorsum attenuata, supra modice convexa; prothorace transverso, basi leviter attenuato, lateribus anticis valde acutis; elytris elongatis, apice acuminatis, supra modice convexis, parce tuberculatis, lineis quatuor post medium disci coalescentibus in singulo instructis.

Long. 17m. m. lat. 8m. m.

The head is finely punctured, with a transverse impression in the middle, a longitudinal ridge above the eyes and two round punctures on the vertex.

The prothorax is transverse, strongly sinuated at the apex, with the lateral angles very acute, attenuated near the base, and with the apical and lateral margins slightly carinated, the former fringed with golden hairs. It is finely punctured and moderately convex above, with an impression on either side of the lateral angles.

The elytra are not broader than the prothorax at the base, slightly broader in the middle, elongated, acuminated towards the apex, moderately convex above, and covered with short tubercles. The suture is raised on the posterior part of the elytra, on each of which are four serrated lines; the first and second coalesce near the middle of the disc, and from there form a single line which coalesces again lower down with the third and fourth, the latter reaching close to the apex.

The underside is strongly plicated longitudinally; the legs are very rugose, the posterior femora much longer than the abdomen and canaliculated on the under side. The claws and spurs are moderately long, and reddish.

Captured by Mr. R. Trimen in Namaqualand.

In the Collection of the South-African Museum.

No. 42.—A. SULCIPYGIA (nov. spec.).

A. elongata, nigra, opaca, apice acuminata, supra sub-plana; prothorace transverso, disco sub-plano, lateribus anticis valde productis, marginibus carinulatis, antica pilis flavidis obsita; elytris elongatis, retrorsum retusis, in singulo carinis validis serratis tribus ad apicem coalescentibus et sulcis quatuor posticis munitis; pedibus longissimis.

Long. 18m. m. lat. 9m. m.

The head is finely aciculated, depressed in the middle, and has a small impression on either side below the ocular ridge.

The prothorax is transverse, strongly sinuated at the apex, slightly carinated all round; the outer angles are very acute in front, and the anterior margin is fringed with yellow silken hairs. It is smooth and somewhat flattened above, and has a faint impression on either side.

The elytra are elongated, not broader than the prothorax at the base but increasing slightly past the middle, acuminated towards the apex, depressed above and retuse posteriorly. Each elytron has three finely serrated ridges, the first and second coalescing near the declivity, the third reaching a little further and all three united at the apex by distinct lines, thus forming four irregular, deep impressions. The interstices have irregular series of very short obtuse tubercles more apparent between the third ridge and the outer margin, the latter is evidently serrated past the middle. The suture is distinct, although not much raised, and has on each side a row of very short tubercles.

The underside is very coarsely corrugated; the legs are very long, slender, and rugose; the spurs and claws are very long and yellowish.

Allied to *A. namaquensis*, but very different from it, and easily distinguished by the deep posterior impressions of the elytra.

From Damaraland, where it was captured by the late Mr. Anderson.

In my Collection.

No. 43.—A. PALGRAVEI (nov. spec.).

A. elongata, sub-nitida, apice attenuata; capite punctato, epistome lobato; prothorace transverso, pone oculos acute lobato, carinato, margine apicali pilis fulvis obsita; elytris elongatis, fuscis vel nigris, sub-ovatis, supra convexis, apice dehiscentibus, vittis sex in singulo sanguineis, sutura margineque laterali sub-elevatis, interstitiis reticulatis; pedibus longis.

Long. 18-19$^{m.}$ lat. 8-9$^{m.\ m.}$

The head is large, acuminated, almost plane above, finely punctured; the epistome is strongly lobated at the apex and separated from the head by a small faintly arcuated impression, the ridges above the eyes are very acute.

The prothorax is transverse, finely punctured, sinuated at the apex with the lateral angles acutely lobated near the eyes, and marginated on the outer and apical sides; the latter has a fringe of yellow hair.

The elytra are not broader than the prothorax at the base, slightly ampliated in the male, more so in the female than in the male, little convex above and declivous at the apex. They are of a fuscous hue and each elytron has six almost obsolete lines faintly reddish; the interstices between these lines are filled with large round impressions coalescing so to form a sort of reticulation; the suture and outer margin are a little raised.

The underside is black, strongly and coarsely plicated. The legs are very long, rugose, the spurs and claws very long and infuscated.

The elytra in some specimens are of a lighter hue than in others.

From Damaraland. Captured by Mr. W. C. Palgrave.

I was greatly surprised on receiving those specimens which had been put alive in carbolised saw-dust, to find the elytra covered with a vesicle which, when punctured, exuded a colourless fluid, and which after dessication adhered to the elytra and partly hid the teguments. I found that the specimen of *A. namaquensis* I have described, had also some part of that pellicle left adhering to the elytra. I had removed the rest, thinking it was due to dirt.

In the Collection of the South-African Museum.

No. 44.—A. FOSSULATA. (nov. spec.)

A. ovata, nigra, supra late foveolata; capite laevi, prothorace rotundato, convexo, antice lateraliterque carinato; elytris ampliatis, apice sub-retusis, fossulis numerosis creberrime adspersis.

Long. 12$^{m.\ m.}$ lat. 10$^{m.\ m.}$

The head is large, narrowed in front, faintly punctured and with a slight plication on the vertex.

The prothorax is smooth, convex, twice as broad as long, and strongly lobated near the eyes.

The elytra are slightly broader than the prothorax at the base, very ovate, convex above, slightly retuse at the apex, and covered with very deep and closely set pits, the interstices of which and also the suture are very shining.

The underside is strongly plicated. The legs and spurs are short.

From Damaraland. Captured by Mr. W. C. Palgrave.

In the Collection of the South-African Museum.

No. 45.—A. EPIPHYSOIDES (nov. spec.)

A. ovata, nigra, opaca; capite laevi, epistome tenuissime punctato; prothorace rotundato, angulis anticis pone oculos acute lobatis; elytris globosis, convexis, laevibus, margine laterali sub-tuberculata.

Long. 19m. m. lat. 15m. m.

The head is large, smooth, with a small impression on either side, the epistome is slightly acuminated and minutely punctured; the ridges above the eyes are small.

The prothorax is broader than long, convex, smooth, lobated in front with the lateral angles acute and the apical and outer sides marginated.

The elytra are broad, very convex and globose, slightly declivous behind, with the suture acute at the apex. They are smooth above, and have very faint traces of tubercles, the outer margin having a somewhat double series of very small conical tubercles forming a kind of serration.

The underside is coarsely plicated longitudinally, the first basal segment of the abdomen more strongly than the others. The legs are short, rugose, the posterior tibiae not much longer than the point of the suture.

Allied to *A. tuberculipennis*, Haag.-Rutenberg, but much more convex.

From Damaraland. Captured by Mr. W. C. Palgrave.

In the Collection of the South-African Museum.

No. 46.—A. STENOCAROIDES (nov. spec.)

S. nigra, ovata, apice acuminata; capite punctato, superciliis elevatis; prothorace convexo, lateribus anticis valde lobatis; elytris ovatis, convexis, apice acuminatis, in medio paulo ampliatis, costis in singulo duabus suturaque elevatis, interstitiis rugosis, reticulatis.

Long. 17-20m. m. lat. 10-13m. m.

The head is large, punctured; the epistome is separated from the head by a deep arcuated impression and is slightly sinuated at the apex; the superciliary ridges are very much raised.

The prothorax is very convex, finely punctured, sinuated at the apex and strongly and acutely lobated near the eyes.

The elytra not broader than the prothorax at the base, are ovate, ampliated in the middle, (nearly twice as broad as the prothorax in the female) acuminated and slightly declivous posteriorly.

They are coarsely punctured and each elytron has two raised lines stopping a little short from the apex. From the median part of the disc, the first discoidal line emits a few raised rami which unite with the suture, thus forming a reticulation; the second discoidal line is

less developed than the first, and between that line and the epipleura are traces of an irregular reticulation more pronounced in the female than in the male. The suture is also raised and ends in two short horizontal spines at the apex.

The underside is finely plicated, the legs are very long and rugose, the posterior coxae are grooved underneath, the tibiae are spinose, the spurs and claws very long and slightly infuscated.

The facies of that species is that of a large *Stenocara* but the lobated prothorax, the tarsi and also the eyes are those of *Adesmia*.

From Damaraland. Captured by Mr. W. C. Palgrave.

In the Collection of the South-African Museum and in my own.

Gen. STENOCARA, Solier.

No. 47.—S. SERICEICEPS, (nov. spec).

S. acuminato-ovata, nigra; capite pilis brevis flavis sericeis tecto; prothorace punctato; elytris sub-reticulatis. lineis tribus in singulo, sutura margineque elevatis, nitidis, epipleuris tricarinatis.

Long. 11-13$^{m.m.}$ lat. 5-8^{m}

The head is thickly covered with silky yellowish hairs, the antennae are black and thicker than in the ordinary *Stenocara*.

The prothorax is broader than long, a little convex above, carinated all round and finely punctured; the anterior angles are acute and the anterior margin has a fringe of yellowish, short hair.

The elytra of the male are not broader in the middle than the prothorax, a little convex above, declivous at the apex and very acuminated. On each elytron are three raised shining lines, the first one from the suture reaches only the top of the declivity, the second one, almost obsolete from the base until the middle of the disc, there becomes developed and acute, although smaller than the other two, and reaches nearer to the apex than the third which is placed at equi-distance from the first line and the outer margin which. like the suture, is raised and shining. The interstices between the suture, the first and second line and the outer margin have large shallow punctures in the middle of which runs an almost obsolete line which is developed only in the apical part, between the first and third line spoken above, and which by dividing the said punctures form a sort of reticulation.

In the female, the elytra are very much broader than in the male, the second apical line is entirely obsolete from the base to the middle of the disc, from there it is developed as in the male; the interstices show a coarse reticulation, and have absolutely no trace of the interstitial lines noticeable in the male. In both sexes, the epipleuræ have three raised very slightly serrated lines. The first one, so close to the outer margin that it causes it to appear double, is the shortest of the

three, the second one and longest runs close to the first, the third one occupies the centre of the epipleura.

The legs are longer in the male than in the female, and very rugose, the posterior tibiae are faintly tuberculated, the spurs and claws are reddish.

Captured by Mr. W. C. Palgrave in Damaraland.

In the Collection of the South-African Museum.

No. 48.—S. DAMARENSIS, (nov. spec.)

Nigra, sub-nitida, ovato-acuminata; capite punctato, sub-piloso in medio; prothorace convexo, utrinque impressione lata notato; elytris acuminatis, cingulo tuberculis acutis duplici serie instructo.

Mas., long. 11$^{m.\ m.}$ lat. 6$^{m.\ m.}$

Fem. long. 11-15$^{m.\ m.}$ lat. 7-9$^{m.\ m.}$

The head is finely punctured and has a small patch of short brownish hair in the centre. The antennae are very slender and reddish.

The prothorax is very convex in the disc, slightly carinated all round, the outer sides are almost straight. It is densely punctured, and has a broad, but not deep impression, on either side of the disc; those impressions are more finely punctured than the other parts of the disc.

The elytra are ovate and acuminated, not much broader at the base than the prothorax in the male, very ampliated in the middle in the female and sensibly declivous at the apex; on each elytron are two series of acute tubercles closely set, and thus forming serrated ridges.

In the male the first ridge runs close to the suture and does not reach the apex, the second one runs close to the lateral margin; the small space between the suture and the first ridge is almost filled by small tubercles forming an irregular line; the broad interstice between the first and second ridges has a few scattered tubercles; the suture is raised and smooth, the outer margin is strongly serrated, the epipleuræ have each two series of tubercles, the first one, very regular, runs along the outer margin and so close as to make it look double, the other is irregular and occupies the centre.

In the female, the interstice between the first ridge and the suture is occupied by a few, elongated, smooth tubercles; the second broad interstice has the same scattered tubercles as in the male, the second ridge diverges more from the outer margin, and the second line of tubercles on the epipleura is much more irregular.

The underside is deeply punctured, and the first three basal segments finely corrugated.

The legs are very long and slender, and slightly reddish, the posterior coxae are a little grooved underneath, the tibiae are rugose.

The two impressions of the prothorax are doubtless filled with a white or brown substance during life.

Captured by Mr. W. C. Palgrave in Damaraland.

In the Collection of the South-African Museum.

Tribe: Moluridae, Lacord.

Gen. PSAMMODES, Kirby.

No. 49.—P. SULCICOLLIS (nov spec.)

P. oblongus, niger, sub-opacus; capite punctato; prothorace deplanato, lateribus granulatis, apice profunde sulcato; elytris oblongo-ovatis, costis in singulo tribus obsoletis, lateribus parteque postica tuberculatis.

Long. 46·50 m. m. lat. 29·22 m. m.

The head is trapeziform and finely punctured, the epistome is separated from the head by a deep transverse impression, the eyes are very much emarginated in front. The antennae are slightly setulose.

The prothorax is a little broader than long, the anterior angles are acute, the outer sides rounded anteriorly and deflexed posteriorly, and the basal margin strongly sinuated; there is a fringe of yellow hair on the apical margin, and a longitudinal impression in the centre of the disc which is almost plane and finely punctured; the sides are strongly granulated, and on the posterior part there is a very deep sulcus, above the basal margin, as broad as the scutellum. The scutellum is large, finely punctured, and pointed at the apex.

The elytra are much broader than the prothorax at the base, and increase in width, being twice as broad in the middle; they are three times as long, moderately convex above, nearly smooth on the upper part of the disc, the outer sides and posterior part are covered with elongated tubercules pointing backwards, very dense and sharper near the apex, where they are much smaller and where are interspersed some very short fulvous bristles. Each elytron has three raised, nearly obsolete, lines; the first from the suture is smooth in the anterior part, and is the most conspicuous of the three which disappear among the tubercles towards the declivity. The epipleuræ are very narrow and smooth.

The underside is convex and rugose. In the male, the metasternum is slightly pilose, the first three anterior segments of the abdomen are covered in the centre with a thick velvety fulvous tomentum which invades also the two last segments. The legs are short, very strong and punctured, and have a ridge of short fulvous bristles on the internal carina; the tarsi have short yellow bristles.

Allied to *P. Rowleianus*, Westw., but much more elongated.

From the Zambezi River and Damaraland.

In the Collection of the South-African Museum and in my own.

Gen. TRACHYNOTUS, Latreille.

No. 50.—T. SCROBICULATUS, (nov. spec.)

T. oblongo-ovatus, niger, nitidus; capite crebre punctato, parce piloso, pone oculos pilis albidis bi-vittato; prothorace rotundato, ampliato, utrinque acuto; elytris ovatis, modice convexis, rugosissimis, singulo costa dorsali instructo.

Long. 14$^{m.\ m.}$ lat. 8 $^{m.\ m.}$

The head is finely granulated, slightly pilose, separated from the epistome by a transverse impression; on each side near the eyes there is a longitudinal line of whitish hair.

The prothorax is opaque, finely granulated, with a smooth longitudinal line in the centre. The apical and basal margins are slightly raised, and both are fringed with short yellowish hair; it is convex above, with the outer sides strongly acute in the middle. The scutellum is large, triangular and granulated.

The elytra are black, shining, slightly broader at the base than the prothorax, ampliated in the middle, acuminated at the apex, convex above, and deeply punctured; the interstices are very rugose and form some irregular reticulations. The middle of the disc is occupied by a raised line which does not reach the apex.

In some specimens, probably females, where the rugosity becomes somewhat reticulated, there is, between the discoidal line and the suture another very obsolete line, shorter than the discoidal one, and another still more obsolete between the latter and the outer margin.

Both suture and outer margin are raised. The epipleurse are smooth near the base, and a little tuberculated and also slightly canaliculated near the apex. The underside, legs, and antennae are pubescent.

From Fraserburg and Prieska, Cape Colony.

In my Collection.

No. 51.—T. IMPRESSICOLLIS, (nov. spec.)

T. ovatus, niger, sub-metallescens, nitidus, pilis brevis fulvis obsitus; prothorace transverso, ad basin late impresso, lateribus obtuse triangulis; elytris conjunctim ovatis, sutura, margine laterali costisque duabus in singulo, elevatis.

Long. 15·17.$^{m.\ m.}$ lat. 7·8$^{m.\ m.}$

The head is moderately long, strongly impressed transversely above the epistome and with a vertical, slightly hollow, impression in the middle. It is finely punctured, and covered with short yellow hair.

The prothorax is truncated in front and behind, with the outer sides much developed and produced in an obtuse triangle; both the apical and basal margins have a small fringe of yellowish hair. It is convex and finely, although not deeply, punctured on the upper side, and has a broad depression above the basal margin, with five longitudinal lines of yellowish hair; the outer margins are also broadly clothed with short hair of the same hue. The scutellum is large, raised, smooth, and shining in the centre.

The elytra are ovate, attenuated and acuminated at the apex, broader than the prothorax at the base, and convex on the upperside. They are black, with a metallic tinge, and covered with short decumbent hair. The suture and the margin are raised, and on the disc of each elytron are two raised lines, the first one shorter than the second; the second, which is in the centre of the disc, is suddenly deflexed at the apex towards the suture which it does not reach, nor does it reach the apex of the elytra.

The underside is covered with short greyish bristles.

The legs are moderately long, and densely covered with short greyish hair. The antennae are pubescent.

From Somerset East, Cape Colony, where it was captured by Mr. Woodroffe, who kindly sent me several specimens.

In my Collection.

No. 52.—T. SERRATUS (nov. spec.)

T. sub-ovatus, niger, supra leviter tuberculatus, pilis longis flavidis parce tectus; fronte sulcata; prothorace transverso, lateribus ampliatis; elytris ovatis, sutura carinata, costis duabus in singulo elevatis, marginibus serratis.

Long. 15$^{m.\ m.}$ lat. 8$^{m.\ m.}$

The head is moderately long, deflexed, with a deep transverse impression separating it from the epistome. It is granulated and has a few short yellowish hairs.

The prothorax is convex above, truncated in front and behind, with the outer sides obtusely triangular and the anterior part of the outer margins distinctly serrated. It is granulated on the upper side and covered with long pale-yellow hair. The scutellum is slightly tuberculated.

The elytra are black, ovate, attenuated at the apex, much broader than the prothorax, and moderately convex on the upper side. The suture and outer margins are raised, the latter serrated; each elytron has two raised lines; the first one is shorter than the second which occupies the centre of the disc and does not reach the apex. The elytra are slightly tuberculated; [the tubercles are more distinct near the outer margin] and dotted with a few long silky yellowish hairs, more numerous near the apex. The epipleurae are canaliculated and slightly tuberculose.

The legs are moderately long, and slightly pubescent.

Captured near Worcester, Cape Colony.

In my Collection.

No. 53.—T. PILOSUS (nov. spec.)

T. oblongo-ovatus, niger, griseo-pilosus; fronte sulcata; prothorace hexagono, tenuiter punctato, supra modice convexo, lateribus pilosis; elytris ob-ovatis, apice acuminatis, sutura costaque dorsali elevatis, vittis quatuor pilosis flavidis in singulo ornatis.

Long 10-13m. m. lat. 5-7m. m.

The head is black, convex, deeply impressed between the antennae, finely punctured, with a patch of greyish hair a little above the anterior part of the eyes. The antennae are a little longer than the prothorax, filiform, greyish and slightly pubescent.

The prothorax is truncated in front and behind, with the lateral angles acute, convex above, finely punctured and with the lateral and basal margins covered with thick, yellowish, short hair. The scutellum is black, small, triangular.

The elytra are black, elongated, three times the length of the prothorax, ampliated in the middle, attenuated and acuminated at the apex, moderately convex above and slightly declivous behind. The suture and outer margins are slightly raised, and each elytron has a single costa in the middle of the disc which does not reach the apex, and four lines, two on each side of the costa, of dense, short yellowish hair. The first one runs along the suture and reaches the apex, the second extends to a short distance from the apical point of the costa, which is reached by the third, and the fourth extends along the outer margin which it covers and coalesces with the first immediately below the costa. The epipleurae are canaliculated and hirtose. The underside and also the moderately long legs are covered with fine greyish short hair.

From Fraserburg, Cape Colony.

In my Collection.

No. 54—T. LUTOSUS (nov. spec.)

T. niger, lutosus, oblongo-ovatus, postice acuminatus; prothorace transverso granulato, carinula velutina, in medio elevata; elytris ovatis in medio leviter ampliatis, conjunctim accuminatis, supra modice convexis, sutura, costis tribus in singulo margineque laterali elevatis; hac reticulata.

Long. 13-14m. m. lat. 7-8m. m.

The head is finely granulated, with a deep transverse impression separating it from the epistome.

The prothorax is transverse, with the sides ampliated in front, the apical and lateral margins are slightly raised; it is convex above, finely punctured, densely pubescent and with a double, raised, longitudinal velvety line coalescing into a single one at the apex; the scutellum is moderately long and triangular.

The elytra are oblong, acuminated at the apex, slightly broader than the prothorax at the base, ampliated in the middle, moderately convex above, and with three raised, acute lines on each elytron; the first one runs alongside the suture, the second one, which is also the longest, occupies the centre of the disc and does not reach the apex; the third one is a little shorter than the median one; the suture is raised like the outer margin along which runs a thin ridge-like impression which is connected with it by transverse folds forming a deep reticulation; they

are finely punctured, and covered with short dense muddy-brown hair.

In some female specimens, the median dorsal line has four teeth-like transverse folds directed towards the third line but not reaching it.

The underside is punctured and covered with very short greyish bristles.

Allied to *T. lacunosus*, Solier.

Captured near the Triangle Stⁿ., Worcester district, Cape Colony.

In my collection.

No. 55.—T. TERRENUS (nov. spec.)

T. sub-ovatus, niger, indumento fusco pilisque brevis tectus; prothorace rotundato-ampliato; elytris ovatis, convexis, singulo obsolete unicostato.

Long. 11-12m. m. lat. 4-5m. m.

Smooth, covered with short bristles and a fuscous substance. The head has a deep transverse impression separating it from the epistome; it is moderately convex, finely punctured and covered with short brownish bristles.

The prothorax is transverse, with the sides slightly ampliated and finely serrated, moderately convex above, covered with a dirty substance and bristling with short rigid hair.

The elytra are ovate, acuminated at the apex, very convex on the upper side, deeply coated with the same substance as the prothorax and with short bristles. Each elytron has a smooth slightly raised line running diagonally from the base towards the suture which it does not reach, nor does it reach the apex. That raised line is evidently formed by denser hairs and squamosities, because on rubbed specimens there is no trace of it left, but a slight depression near the base.

The underside and legs are finely punctured, and covered with short greyish bristles.

From Prietzka, Orange River.

I am indebted for several specimens of this insect to Dr. Gibbons who kindly sent them to me.

In my Collection.

No. 56.—T. DUBIUS (nov. spec).

T. elongatus, sub-ovatus, niger, pilis griseis inaequaliter adspersus; capite profunde impresso; prothorace transverso, basi apiceque sinuato, lateribus rotundatis; elytris pilosis, elongatis, sub-ovatis, apice conjunctim acuminatis, sutura, margine laterali carinisque tribus in singulo, elevatis.

Long. 14m. m. lat. 6m. m.

The head is very deeply impressed above the epistome, finely punctured, and has faint traces of villosity.

The prothorax is moderately convex above, sinuated at the base and apex, the outer sides are rounded; it is finely punctured and covered with short greyish decumbent hairs. The scutellum is large, triangular and finely punctured.

The elytra are slightly broader at the shoulders than the prothorax, elongated and a little ampliated in the middle, much acuminated at the apex, moderately convex on the upper side, smooth, opaque, with the suture and outer margins raised and with three lines on each elytron; the first one from the suture is short, the median one is longer, the third as long as the median one coalesces nearly with it and stops at a short distance from the apex. The interstices between the raised lines are densely covered with short decumbent greyish hairs.

The underside and legs are opaque, finely punctured, and hairless.

General facies of *T. vittatus*. Fabr.

I believe that this insect comes from Damaraland, but I am not quite sure of it.

In my Collection.

Gen. CLINOCRANION, Solier.

No. 58.—C. LATEMARGINATUM (nov. spec.)

C. oblongum, nigrum, capite crebre punctato, prothorace transverso, lateribus obtuse angulatis; elytris oenescentibus, nitidis, costa marginali retrorsum abbreviata sub-serrataque, epipleuris rectis, costa serrata in medio instructis; pedibus gracilibus, tibiis rufescentibus.

Long. 18$^{m.\ m.}$ Lat. 8$^{m.\ m.}$

The head is large, deflexed, finely punctured, separated from the epistome by a deep semi arcuated impression; it has a small vertical impression on the vertex.

The prothorax is finely punctured, transverse, with the sides slightly ampliated and forming an obtuse triangle; it is slightly marginated all round.

The scutellum is short, and finely punctured.

The elytra not broader than the prothorax at the base, and slightly ampliated in the middle, are oblong, acuminated at the apex, and coppery black. The disc is plane and very rugose, the posterior part is strongly detriscent. Between the marginal ridge, which reaches only to the declivity where it is obsoletely serrated, and the suture, there is a smaller ridge, faintly tuberculated, extending as far as the marginal one. The epipleuræ are very broad, perpendicular, and have a very conspicuous serrated ridge in the centre extending as far as the apex where the serration is very strong. The underside is finely punctured, very slightly pubescent; the legs are moderately long, black, the tibiae are reddish.

I am not quite sure that this insect is not an intermediate form between the *T. aeneus* and the genus *Clinocranion*. The antennae are

those of *Clinocranion*, but the first article of the tarsi is not longer than the last. The form of the epipleura however, justifies my placing it in this genus.

From Rustenberg, Transvaal.

In my Collection.

No. 57.—C. Alstoni (nov. spec.)

C. nigrum, oblongum, apice acuminatum; prothorace rotundato, ante basin leviter emarginato; elytris tuberculatis, in disco deplanatis, retrorsum dehiscentibus acuminatisque, carina dorsali valida, sub-serrata, costisque duabus rufescentibus, in singulo munitis; epipleuris sub-rectis, marginibus suturaque rufescentibus.

Long. 20m. m. lat. 19m. m.

The head is large, deflexed, granulated and separated from the epistome by a very deep impression. The antennae are filiform, slightly pilose, black, the two apical articles yellowish. The eyes are very strongly granulated.

The prothorax is rounded, longer than broad, the outer sides are slightly sinuated towards the margin. It is a little convex above and finely granulated. The scutellum is moderately large, triangular and granulose.

The elytra are oblong, broader than the prothorax at the base, ampliated towards the middle and acuminated at the apex. They are covered with very numerous, short, sharp tubercles. The disc is plane anteriorly, and separated from the epipleuræ by a strong ridge, slightly serrated at the apex, extending to beyond two-thirds of the length of the elytra which from there are very dehiscent. On each elytron are two slightly raised but very distinct reddish lines, the first one on the disc between the suture and the marginal ridge, the second in the epipleura, close to the discoidal ridge; those two lines coalesce a little before the apex; the epipleuræ are not quite vertical, their outer margin and also the suture are reddish, the latter is very slightly serrated.

The legs are slender, very rugose, the tibiae covered with very short whitish bristles, the underside finely punctured.

I have only seen female specimens, and it is very likely that in the male the two raised reddish lines will be less distinct and the epipleurae nearly vertical.

This interesting insect was captured by Mr. E. G. Alston, after whom I propose to name it.

From Fraserburg, Cape Colony.

In the Collection of the South-African Museum.

Tribe : Opatridae, Lacord.

Gen. ANOMALIPUS, Guérin.

No. 59.—O. DECOSTERI (nov. spec.)

Pl. 4 fig. 5.

A. oblongus, deplanatus, opacus ; prothorace ante medium dilatato, hexagono, supra areolis, duabus lævibus notato ; elytris granulosis, singulo tuberculis tribus insignis, seriatim positis, margine laterali sinuata ; tibiis angustis, anticis bi-dentatis.

Long. 25m. m. lat. 12m. m.

The head is depressed, cleft at the apex and rugose. The slightly setulose antennae do not reach the middle of the prothorax which is very broad a little before the middle, rounded anteriorly and with the posterior angles acute. The disc is a little convex, and has two slightly raised shining tubercles.

The elytra are parallel, plane, narrower than the prothorax, dehiscent near the apex and thickly covered with small, closely set tubercles. On each elytron are three conspicuous shining tubercles, the first one placed a little before the median part of the disc, the second, the largest of the three, is in the centre, and the third one at the top of the declivity.

The underside of the body is black, and slightly shining. The legs are rather long and narrow, and deeply punctured; the posterior femora are slightly arcuated, the anterior tibiæ are curved at the apex and bidentate.

From Delagoa Bay.

I have received this singular insect from my friend Mons. de Coster, to whom I am indebted for many rare and curious insects from that locality, and after whom I propose to name it.

Family : LAGRIIDÆ.

Tribe : True Lagriidæ, Lacord.

Gen. ADYNATA, Fahreus.

No. 60.—A. EUTRAPELOIDES (nov. spec.)

A. oblonga, parce pilosa, fere linearia, antennis infuscatis ; capite, prothorace, femoribus corporis subtusque viridi-cyaneis ; elytris tibiisque flavis, illis concinne punctatis.

Long. 6$^{m.\ m.}$ lat. 3$^{m.\ m.}$

The head is large, narrowed behind, punctured, and separated from the epistome by a deep transverse impression. The antennae are infuscated, short, reaching the shoulders only. The prothorax is nearly globose, finely punctured, marginated at the base, very convex above. The head and prothorax are of bright, shining, blueish-green, and have a few short hairs. The scutellum is small and green.

The elytra are pale-yellow, somewhat shining, four times the length of the prothorax, convex above, nearly linear, rounded and, somewhat declivous at the apex; they are finely striated, the striae are deeply punctured.

The underside is brillant coppery green and so are the femora. The coxae and tibiae are pale-yellow, the tarsi ferruginous, with the apical article much dilated.

From Leydenberg, Transvaal.

In the Collection of the South-African Museum.

Gen. EUTRAPELA, Blanchard.

No. 61.—E. PLAGIATA (nov. spec.)

E. elongata, testacea, glabra, supra opaca, subtus nitida; prothorace rufo, laevi, basi distincte marginato, antennis, articulo primo secundoque excepto, capite, pedibus, pectore abdomineque nigris; elytris flavis, regulariter punctato-striatis, postice plaga magna, communi, elongata, violacea submicante ornatis.

Long. 9·10$^{m.\ m.}$ lat. 3½-4$^{m.\ m.}$

The head is sub-rhombic, slightly punctured, with the epistome separated from the forehead by a deep transverse impression. The palpi are infuscated, with the exception of the three first articles which are reddish. The prothorax is red, smooth, elongated, convex above, truncated in front, with a raised basal margin and a faint longitudinal depressed line in the middle. The scutellum is black.

The elytra are testaceous-yellow, three times the length of the prothorax, much broader at the base, slightly convex above, and attenuated at the apex; they are covered with fine striae filled with punctures. A little beyond the middle of the disc, there is a large violaceous moderately shining patch, situated at the base and covering the posterior part of the disc, but not invading the outer margins.

The legs are black; the tarsi infuscated; the pectus and abdomen shining black.

The postical patch is of a deeper violet in some specimens.

Captured near Maritzburg, Natal, by my friend Mr. A. S. Windham, to whom I am indebted for many entomological specimens captured in that locality.

In my Collection.

No. 62.—E. CINGULATA (nov. spec.).

E. elongata, cuprea, glabra, supra sub-opaca, subtus nitida; labro, epistome, antennis, palpis pedibusque flavidis; elytris regulariter punctato-striatis, disco plaga magna elongata pallide-flava.

Long. $10^{m.\,m.}$ lat. $3^{m.\,m.}$

Head sub-rhombic, depressed above, separated from the epistome by a deep transverse impression, punctured anteriorly, and with a short impressed line on the vertex. The palpi and antennae are pale-yellow.

The prothorax is elongated, truncated in front and behind, with a distinct raised basal margin, convex above, with a conspicuous longitudinal depressed line in the centre and a deep impression on either side. It is coppery-green like the head. The scutellum is triangular and green.

The elytra are coppery-green, broader than the prothorax at the base, linear, slightly convex above, attenuated at the apex, and with deep striae filled with regular punctures; the disc is occupied a little beyond the humeral angles by an elongated pale-yellow patch reaching the apex, and leaving only the suture, the outer magins, and the basal part coppery-green turning to violet near the scutellum.

The legs are pale-yellow, and the underside very shining.

Variety A. In that variety, the discoidal patch has become slightly brassy-green, and the suture, base, and outer margins are therefore less conspicuous.

From Maritzburg, Natal.

In my Collection.

No. 63.—E. AMABILIS (nov. spec.)

E. elongata cyanea, sub-nitida; antennis, labro, pedibus margineque laterali thoracis flavis; elytris concinne punctato-striatis.

Long $10^{m.\,m.}$ lat. $3^{m.\,m.}$

The head is sub-rhombic, depressed above, separated from the epistome by a deep impression: the palpi are black; the epistome, labrum and antennae are pale yellow, the latter very long.

The prothorax is convex above, smooth, without any impression in the middle, truncated in front and behind, and with the base slightly marginated. It is of a shining dark-blue above, with the lateral margins and the whole underside pale-yellow. The scutellum is small and dark-blue.

The elytra are elongated, very slightly convex above, attenuated at the apex and striated. The striae are closely set and filled with deep punctures. The lateral margins are dotted with a few fine bristles,

longer at the apex. The pectus and abdomen are shining blue, with the sides of the three apical segments slightly reddish. The legs are pale-yellow.

From Leydenburg, Transvaal.

In the Collection of the South-African Museum.

No. 64. E. METALLESCENS (nov. spec.)

E. elongata, sub-opaca, obscure cuprea; epistome, antennarum basi pedibusque rubro-fuscis, elytris concinne punctato-striatis.

Long 7m. m. lat 2m. m.

The head is sub-rhombic, plane above, separated from the epistome by a deep impression, and slightly punctured. The epistome, palpi and antennae are reddish black, with the exception of the three first articles of the antennae which are red. The antennae are very long.

The prothorax is elongated, convex above, truncated in front and behind, and with the basal margin raised. It has a faint longitudinal impression in the centre.

The elytra are elongated, linear, slightly convex above, attenuated at the apex and have deep, finely punctured striae; they ar · of a metallic somewhat cupreous hue, slightly less deep than on the prothorax.

The underside is shining, with the pectus, apical and abdominal segments and legs somewhat reddish.

From Maritzburg, Natal.

In my Collection.

No. 65.—E. FLAVIPENNIS (nov. spec).

E. elongata, nigra, glabra, antennis, pedibus prothoraceque piceis, his marginibus tenue flavis; elytris concinne punctato-striatis, pallide flavis.

Long 9-10m. m. lat. 3-4m. m.

The head is sub-rhombic, punctured, with a deep impression on the vertex and separated from the epistome by a deep impression. The epistome, the labrum and the antennae are black.

The prothorax is convex, elongated, smooth, slightly ampliated on the sides, truncated in front and behind, and with the basal margin raised. It is shining black above, with the apical, basal margin, and also the underside yellow.

The elytra are four times the length of the prothorax, broader at the base, linear, convex above, slightly attenuated at the apex and with closely set, finely punctured striae. The lateral margins have a few slender bristles longer near the apex. The underside is shining. The pectus and abdomen are black in the male, the three basal segments of the abdomen reddish in the female; legs black, shining.

From Leydenburg, Transvaal.

In the Collection of the South-African Museum.

No. 66.—E. PROXIMA (nov. spec).

E. elongata, viridi-aenea, glabra, supra sub-nitida; capite prothoraceque viridi-aeneo; elytris concinne punctato-striatis, pallide flavis.

Long. 9m. m. lat. 3½m. m.

The head is coppery green, sub-rhombic, punctured; the labrum acuminated, the epistome separated from the head by a deep impression; the palpi and antennae are reddish at the apex.

The prothorax is oblong, very convex above, the convexity greater in the female, rounded on the sides and with the basal margin distinctly raised. It is smooth, shining, coppery green.

The scutellum is also green and shining.

The elytra are pale yellow, broader than the prothorax, linear, slightly attenuated at the apex, convex above, the convexity greater in the female, and with finely punctured striae. The suture in the female is green below the scutellum and the outer margins have a few bristles longer near the apex. The underside and legs are brilliant dark-green.

In some specimens, the underside of the prothorax and also some of the abdominal segments are reddish, but those characters are subject to great variations.

Is allied to the preceding species, but differs in the shape of the prothorax which is shorter and more globose.

From Knysna, Cape Colony.

In my Collection.

No. 67.—E. UNICOLOR (nov. spec.)

E. elongata, obscure cyanea, sub-nitida, pilis longis erectis inaequaliter adspersa; antennis palpisque nigris; prothorace transverso, apice sub-marginato; elytris leviter scrobiculatis.

Long. 9m. m. lat. 4m. m.

The head is broad, slightly hirsute, punctured, separated from the epistome by an arcuated impression; the labrum is quadrate, the antennae and palpi black.

The prothorax is nearly quadrate, slightly attenuated at the base and rounded on the sides, which are marginated, truncated in front and behind, with the basal margin slightly raised, convex above, as broad as long, and with a small transverse impression in the posterior part of the disc which is irregularly punctured and covered with long erect thin hairs. The scutellum is black.

The elytra are broader than the prothorax, linear, convex, deeply and irregularly punctured, and covered with blackish erect hairs.

The underside and legs are very shining, the latter slightly hirsute.

I believe this species to be the *E. unicolor* of Dejean's catalogue.

Captured in Koeberg, Cape Colony.

In my Collection.

Family: ANTHICIDÆ:

Gen. FORMICOMUS, Laferté.

No. 68.—F. RUFESCENS (nov. spec.)

F. nitidus, rufescens, parce pilosus, prothorace pallide-rubro, antice inflato, postice attenuato, elytris rufescentibus, vage punctatis, post humeros depressis, pilis nonnulis pallidis obsitis.

Long, 4½-5 m. m. lat. 1¼-1½ m. m.

The head and antennae are reddish; the prothorax is of a lighter hue, shining, very convex, and rounded anteriorly, very much narrowed near the base and has a deep, hollow, impression on either side of the posterior part of the outer margin. It is punctured, and from the punctures spring short, decumbent, palid hairs.

The elytra are infuscated, ovate, and elongated; they have a deep transversal impression behind the shoulders, and are vaguely punctured and covered like the prothorax with decumbent bristles, a little longer than on the latter.

The underside and legs are pale red, the anterior tibiæ are strongly toothed underneath in the three specimens in my possession. It is doubtless an attribute of the male because some specimens of *F. rubricollis* to which the *rufescens* is closely allied, in my collection have the same tooth although not quite so developed. Laferté described the *rubricollis* from female specimens.

From Maritzburg, Natal.

In my Collection.

Gen. NOTOXUS, Geoffroy.

No. 69.—N. SERICEUS (nov. spec.)

N. pallide-testaceus, pilis sericeis dense tectus; prothorace subsphærico, cornu angusto, elongato, serrato; elytris punctatis, singulo plaga parva, transversali, nigra, ornato; antennis pedibusque testaceis.

Long 2¼ m. m. lat 1 m. m.

The head is blackish, the eyes large, granulated, the antennae pale-yellow.

The prothorax is sub-spherical, pale-yellow, covered with a long silky pubescence, the thoracic horn is long and strongly serrated on the sides.

The elytra are pale-yellow, punctured and covered like the prothorax with a silky pubescence; towards the middle there is on each elytron a transverse blackish patch slightly sinuated, which begins at a little

distance from the suture reaches the margin and follows it to a little distance from the apex. This patch is partially hidden by the pubescence.

The pectus and abdominal segments are infuscated, the legs are pale yellow.

From Hex River, Cape Colony.

In my Collection.

Family: MELOIDÆ.

Gen. MELOE, Linné.

No. 70.—M. HOTTENTOTUS (nov. spec.)

M. cyaneus, nitidus, antennis longis, articulis 5—7 in mare incrassatis, compressis; prothorace elongato, profunde punctato; elytris aciculatis.

Long. 13·22$^{m.\ m.}$ lat. 4-7$^{m.\ m.}$

The head is deeply punctured and separated from the epistome by a longitudinal impression; the antennae are long reaching as far as the middle of the elytra; in the male the 5 and 7 article are enlarged and compressed, the 6, the largest of the three is hollowed; the palpi are black and slightly infuscated at the tips.

The prothorax is deeply punctured, slightly convex on the upper side, attenuated near the base the margin of which is slightly sinuated; above the basal margin is a slight depression, and the outer sides are perpendicular.

The elytra are broader than the prothorax and three times as long. They diverge greatly from the middle and are finely aciculated. The abdomen and underside are finely punctured.

The legs are coppery dark-blue, the tarsi are very slightly hirtose underneath.

From Port Elizabeth, Cape Colony, and Leydenberg, Transvaal.

In the Collection of the South-African Museum.

No. 71.—M. CAFFER (nov. spec.)

M. cyaneo-purpurascens; antennis brevibus, capite prothoraceque profunde punctato, hoc in medio profunde canaliculato; elytris striato-rugulosis, striis undulatis; subtus cyaneus.

Long 15·25$^{m.\ m.}$ lat. 5·8$^{m.\ m.}$

The head has broad irregular punctures, and is separated from the epistome by an arcuated impression; on the vertex is a very conspicuous groove. The antennae are black and short, only reaching the base of the prothorax.

The prothorax is very deeply and irregularly punctured, broad, a little longer than broad, the outer margins are almost straight, the sides perpendicular and the basal margin strongly sinuated in the centre; it is plane above and on the middle of the disc there is a deep groove reaching from apex to base.

The elytra are short, blueish-purple like the head and prothorax, and strongly striated, with the striae rugose and undulating.

The abdomen and underside are dark blue and finely punctured.

Allied to *M. angulatus*.

From Maritzburg, Natal, and Leydenberg, Transvaal.

In the Collection of the South African Museum and in my own.

Family: CURCULIONIDAE.

Tribe: Brachyderidæ, Lacord.

Group: Tanymecidæ.

Gen. POLYCLOEIS Schönherr.

No. 72.—P. MACULATUS (nov. spec.)

C. oblongus, niger, squamulis silaceo-ochraceis adspersus; rostro sulcato, thorace leviter rotundato-ampliato, apice constricto, lateribus liturisque tribus in elytris densius cretaceo-squamosis.

Long. 11. 12. m. m. lat. 4 m. m.

The head is finely punctured, sub-quadrate, black covered with short hairs and also a few scales; the rostrum is longer and a little narrower than the head, and has a deep longitudinal sulcus in the middle which does not reach the apex; the eyes are globose, large; the antennae greyish and pilose could reach no further than the middle of the prothorax.

The prothorax is longer than broad, truncated in front and behind, slightly ampliated in the middle, a little narrowed at the apex, convex above, punctured, and covered with small cretaceous scales very dense on the outer margins. The scutellum is obtusely triangular and scaly.

The elytra are but slightly rounded at the humeral angles, one half

broader than the prothorax, not ampliated in the middle, rounded at the apex, with the apical suture acuminated and slightly pilose. They are striated, the striae filled with punctures deeper at the base, and there are also some scattered scales forming three dense patches; the first, a little before the middle, reaches from the outer margin to about the middle of the disc; the second is round and placed near the suture, a little beyond the middle; the third, the smallest of the three, is close to the outer margin, a little before the apex. The underside is black, scaly, the legs hairy and reddish.

In some specimens, the first transverse band ascends the outer margins and reaches the shoulders.

From the Zambesi River, captured by the late Dr. Bradshaw.

In the Collection of the South-African Museum and in my own.

No. 73.—C. VARIEGATUS (nov. spec.)

C. oblongus, niger, squamis ochraceis vestitus; rostro sulcato, prothorace rotundato-ampliato, antice leviter constricto; elytris punctato-striatis, apice sub-mucronatis.

Long. 13-14$^{m.\ m.}$ lat. 5$^{m.\ m.}$

The head is sub-quadrate, black, hairy and scaly. The rostrum is very little longer than the head. It has a deep groove in the middle which does not reach the apex and continued, though smaller, on the anterior part of the head. The eyes are globose, the antennae reddish at the base, grey and pilose.

The prothorax is longer than broad, truncated in front and behind, rounded and slightly ampliated on the sides, a little attenuated in front, finely punctured and covered with ochraceous scales.

The elytra are nearly twice as broad as the prothorax, the humeral angles are strong and a little rounded; they are straight, rounded and hardly acuminated at the apex, the apical suture has a small tooth. They are convex above, striated, the striae punctured; the punctures are deeper near the base, and the interstices are covered with ochraceous more or less dense scales. The underside is black, very scaly; the legs are reddish, hairy.

General facies of the preceding species, but more robust.

From the Zambesi River. Captured by Dr. Bradshaw.

In the Collection of the South-African Museum and in my own.

Gen. HYPOMECES, Schönherr.

No. 74.—H. IMPRESSICOLLIS (nov. spec.)

H. niger, sub-nitidus, squamulis nonnulis griseis parce vestitus; capite rostroque profunde canaliculatis, prothorace transversim pone basin late impresso, antice longitudinaliter sulcato; elytris oblongis, apice acuminatis, profunde punctato-striatis, interstitiis sub-convexis.

Long. 12$^{m\ m}$. lat. 4$^{m.\ m}$.

The head is sub-quadrate, plane, with a very deep median groove continued on the rostrum and reaching nearly the apex; the rostrum is slightly deflexed and angular, very little longer than the head, finely rugose, slightly hairy at the apex; the eyes are globose, and very prominent.

The prothorax is as broad as long, and rugose; it has a very deep transverse impression near the base and a longitudinal groove in the middle, beginning a little beyond the apex.

The elytra are oblong, attenuated from the median part towards the apex, broader at the base which has the humeral angles developed in a distinct callus; they are convex above, striated, the striæ deeply and broadly punctured, the punctures are less deep at the extremity of the elytra; the interstices are moderately convex, and dotted with a few very small whitish scales.

The underside and legs are clothed with very fine greyish hair.

From the Zambezi River.

In the Collection of the South African-Museum and in my own.

No. 75.—H. MODESTUS (nov. spec.)

H. niger, squamosis albido-opalinis vestitus; capite rostroque canaliculatis; prothorace modice elongato, supra convexo, tenuiter canaliculato, in medio disci utrinque impresso; elytris elongatis, apice rotundatis.

Long. 10$^{m.\ m.}$ lat. 3$^{m.\ m.}$

Densely covered with greyish-white scales of an opaline hue. The rostrum is slightly deflexed at the apex, hardly longer than the head; it has a small, yet deep groove reaching the base of the head, and also a curved impression on either side. The head is plane, densely covered with scales, like the rostrum. The eyes are large, globose and prominent.

The prothorax is a little longer than broad, densely covered with scales, rounded on the sides, truncated in front and behind, very little convex above; it has a longitudinal median impression and another transversal one in the middle of the disc partly hidden by the scales. The scutellum is triangular.

The elytra are broader by one-half than the prothorax at the base, straight, rounded and slightly attenuated at the apex, moderately convex above, and finely striated, with the striæ punctured.

The underside and legs are slightly pilose and scaly.

From Potchefstroom, Transvaal.

In my Collection.

Tribe: BRACHYCERIDAE.

Gen. BRACHYCERUS, Olivier.

No. 76.—B. TURSIO, Pascoe.

Variety: INSIGNIS. Pl. 2. fig. 3.

Long. 23$^{m.m.}$ lat. 12$^{m.m.}$

Ovate, black, covered with a cretaceous white coating.

The head between the superciliary ridge has a fuscous squamose coating. On the middle of the disc of the prothorax is an almost smooth longitudinal ridge, and on the anterior part two obtuse denuded crests forming a triangle.

The elytra are globose, covered with a whitish substance, but they are evidently punctured. Near the shoulders are two denuded spaces on each elytron, containing round, fulvous, white-circled spots and another in the posterior part near the suture.

The size of the denuded space and the number of ocelli-like spots contained therein seem to be subject to much modification.

From Damaraland.

In my Collection.

No. 77.—B. INTERMEDIUS (nov. spec.)

B. ovatus, niger, rostro impresso, marginibus elevatis; prothorace utrinque spinoso, rugis duabus dorsalibus elevatis carinulam includentibus instructo; elytris ovatis, convexis, verrucosis, maculis ferrugineo-squamosis sub seriatim positis, ornatis.

Long. 19-23$^{m.m.}$ lat. 10-12$^{m.m.}$

The rostrum is long, impressed in the middle; the lateral margins are raised and separated from the head by a deep arcuated impression. The head is small, and has a longitudinal impression on the vertex, and is depressed on either side. The eyes are perpendicular, depressed, and have a thin superciliary ridge.

The prothorax is narrowed in front and behind, the sides are produced in an acute spine; it is strongly tuberculated above, and in the middle there is a deep cavity formed by two raised semi-tuberculated ridges interrupted in the middle, curved in the anterior and straight in the posterior part and with a small straight ridge in the middle. On each side of the disc, between the lateral spine and the median ridge, there is a conspicuous, elongated, squamose, ferruginous patch.

The elytra are ovate, very convex, slightly declivous at the apex, more elongated in the female than in the male. The sides are deeply

punctured and the upper surface is dotted with small round granule-like tubercles irregularly disposed but forming however, two distinct lines on each elytron. The suture is dotted on either side with semi-conspicuous tubercles. Squamose ferruginous dots are disposed in series more regular on the disc than on the sides.

The underside is black, with the sides of the abdominal segments, the pectus, coxae and the underside of the tibiae coated with cinnabar-red scales.

Allied to *B. apterus*, var. *Dregei*, by the sculpturing of the head and prothorax and to *B. maculatus* by the general form.

From Leydenberg and Rustenberg, Transvaal.

In the Collection of the South-African Museum, and in my own.

No. 78.—B. SQUAMOSUS, (nov. spec.)

Pl. 2, fig. 4.

B. ovatus, niger, supra squamulis fusco-cinereis inæqualiter obsitus; fronte arcuatim impressa, supra oculos cristata; prothorace sulcato in medio, lateribus acute spinosis; elytris confertim granulatis, maculis silaceo-squamosis ornatis.

Long. 24m. m. lat. 14m. m.

The head is a little broader than long, and punctured. It has a transverse impression forming a ridge above the eye and is separated from the rostrum by a deep arcuated groove. The eyes are very depressed and cordiform. The rostrum is twice the length of the head, much enlarged and plane at the apex, canaliculated from the base to the middle and has a few bristles at the apex. The extremity of the rostrum and the head between the eyes, are scaly.

The prothorax is convex, a little broader at the base, and with the outer sides projecting in a sharp, long, conical spine. It is covered with rounded confluent tubercles, and has a deep cavity in the centre, deeper and broader in the anterior part of the base, and also two deep impressions on each side of the cavity. The median groove, the upper side of the prothorax including the spines, and the whole of the underside of the prothorax are coated with glossy, yellowish scales.

The elytra are not broader than the prothorax at the base, much rounded in the middle, ovate, very convex, and covered with round setifer tubercles and with six lines on each elytron of silky raised spots forming a somewhat cloudy design on the disc. The scaly spots of the first and second line from the suture are more raised than the others and interspersed with a few shining tubercles. The underside is punctured and scaly. The ventral segments have two lateral and one median series of reddish spots. The legs are strong, black, covered with very short thick bristles. The posterior tibiae have on the outer part two curved, long, conical spurs, the upper twice longer than the other.

Judging from the description only, this species must be very near to B. *ochreo-signatus*, Fahræus. But Professor Aurivilius of the Stockholm Museum, who has kindly compared my specimens with those in that Museum, declares it to be a different species.

Found in the Collection of the late Mr. Anderson, and probably captured in Damaraland.

In my Collection.

No. 79.—B. Albotectus (nov. spec.)

Pl. 2. fig. 5.

B. oblongo-ovatus, niger, indumento albido tectus; rostro plano, leviter carinato, basi divaricato, punctato; prothorace profunde canaliculato, apice tuberculato, postice laevi, nitido, lateribus obtuse squamosis; elytris sub-laevibus, indumento albido tectis, vittis in singulo sex denudatis.

Long. 19m.m. lat. 10m.m.

Black, covered with whitish squamosities. The rostrum is sinuated on either side, slightly raised in the middle, with the basal median part deeply impressed so as to form a callus on either side. It is smooth and shining in the middle, punctured, and with the sides and apex covered with short hairs and scales. The head is small and separated from the rostrum by a deep transverse impression.

The prothorax is convex, punctured in the anterior part, smooth and shining black (denuded) behind, a little narrowed in front, broadening diagonally and produced in an obtuse conical spine on either side, from there tapers towards the base, the margin of which is arcuated and broader than the apical one; there is a deep median groove in the disc, deepening towards the base. On each side of the groove the disc is very much raised, forming two large smooth callosities; it is sinuated at the base, and slightly overhangs it. The median groove, the lateral sides which are slightly tuberculated, and the underside of the prothorax are coated with white.

The elytra are three times the length of the prothorax, not much broader at the base, rounded and a little enlarged beyond the humeral angles, declivous at the apex, convex above, and each elytron has six raised smooth lines. They are covered with white squamosities, but the suture, the first line, which does not begin quite at the base, the 2 and 4th discoidal and the two lateral ones are denuded and shining. The interstice between the first and second line is denuded as far as the top of the declivity. The underside is squamose and denuded here and there.

The general facies is that of *B. cordiger*. The cretaceous covering is, so far as I know, restricted in that genus to the present species, *B. oblongus* Fahr. & *B. tursio*. It is doubtless useful to the insect for concealment, and Mr. Th. Ayres, from whom I got my specimens of

B. oblongus, informs me that he captured them in the white corolla of the Aroid *Richardia aethiopica*.

From Damaraland.

In my Collection.

No. 80.—B. IMPRESSICOLLIS (nov. spec.)

Pl. 2. fig. 1. and 1. a.

B. oblongus, niger, squamulis terrenis indutus; rostro longo, sub-curvato, canaliculato; orbitis planis; prothorace quadrato, antice fortiter impresso, angulis in callo magno impressionem leviter impendente productis, ante medium canaliculato; elytris rude reticulatis, supra triseriatim tuberculatis, tuberculis exterioribus posticisque conicis, acutis, setiferis; femoribus tibiis tarsisque cinnamoneo-squamosis.

Long. 25-27$^{m.m.}$ lat. 12-13$^{m.m.}$

The rostrum is very long, curved, twice broader at the apex than at the base, marginated in the middle, canaliculated posteriorly, and squamose. The head small, punctured, squamose, separated from the rostrum by an arcuated impression has no superciliary ridge.

The prothorax is deeply impressed in front on either side, and has a raised part in the middle that looks, seen from above, like the continuation of the head; it is not broader than the latter and is deeply grooved, the groove reaching only the third anterior part of the disc. The outer sides are produced in a large semi-obtuse callus formed by the agregation of several tubercles. They are slightly attenuated towards the base, and run at right angles with the end of the median discoidal groove, giving to the prothorax a trapezoid shape. The posterior two thirds of the disc are plane and have large punctures filled with a brown substance.

The elytra are twice and a half the length of the prothorax, not much larger at the base, increasing to twice the width of the latter immediately beyond the middle. They are roughly reticulated and each one has on the disc three rows of conical tubercles carrying a few short fulvous bristles. These tubercles, nine in number in the first row from the suture, are small near the base and become larger near the declivity; the three posterior ones are the largest; the second row has only six tubercles and there are seven in the third (the basal one beginning right above the coxae of the median legs) which coalesces under the second line with the first, this line alone reaching the apex.

The underside is black and has a few scattered squamose hairs. The legs, antennae and tarsi are covered with a cinnamon squamose coating, and the legs are dotted with a few brown bristles.

In one specimen in the Collection of the South African Museum the outer row of tubercles has become almost obsolete and the tubercles of the first and second row are very blunt. The whole body is covered with a dense brown substance.

From Rustenberg and Leydenberg, Transvaal, and Bathurst, Cape Colony.

In the Collection of the South-African Museum and in my own.

No. 81.—B. LOBATICOLLIS (nov spec.)

Pl. 2. Fig. 2.

B. oblongus, niger, fusco-squamosus; rostro disperse punctato, basi tuberculato; prothorace brevi, canaliculato, apice profunde bi-sinuato, vertice cristato, lateribus valde elevatis, supra late sulcato, tuberculis conicis confertim obsito; elytris fuscis, singulo plaga laterali albida tuberculisque setiferis in serie quinquplice positis, obsito.

Long 19m. m. lat. 10m. m.

Oblong, black, covered with brown squamosities and with a white longitudinal band on each side. The rostrum is large, thick at the apex, and has two short tubercles above the place of insertion of the antennæ, a small raised line in the middle and the basal margins produced in two acute spines. It is separated from the head by a very deep and broad impression. The head is very small and has an impression in the centre. The eyes are lateral, depressed, and without any superciliary ridge. Both head and rostrum are covered with whitish squamosities.

The prothorax is deeply lobated at the apex and has a tubercle on each side forming a sort of crest; the sides are much raised, produced obliquely upwards and sloping towards the median groove. It is covered with closely set conical tubercles, and densely covered with fulvous squamosita.

The elytra are broader than the prothorax, moderately convex, truncated at the apex, nearly parallel on the sides, and deeply punctured, the interstices forming on each elytron five dorsal rows of raised conical setifer tubercles. The first row from the suture is the most conspicuous; it has a basal callus and is the only one which reaches the apex. Beside those five rows there are three lateral ones not much raised. The elytra are covered with a fulvous squamose coating and a little beyond the basal callus of the second row there is on either side a white squamose band covering the fourth and fifth interstice and on the vertex of the declivity there is also on both sides of the suture an irregular spot of the same substance.

The underside and legs are covered with ochaceous scales.

Probably from Damaraland.

In my Collection.

No. 82.—B. SPECIOSUS (nov. spec.)

Pl. 3, fig. 1.

B. niger, transversus; rostro sub-brevi, lato, supra ruguloso, basi arcuato orbitis elevatis; prothorace utrinque acute spinoso, in disco costis duabus sub-lævibus carinaque media elevatis; elytris sub-plicatis, tuberculis conicis duplici serie in singulo instructis.

Long. 25.m. m. lat. 13m. m.

The head is short, impressed on either side, and has a raised line in the middle; it is separated from the rostrum by a triangular groove. The eyes have a prominent superciliary ridge. The sides of the prothorax are produced in a long and strong conical spine, the point of which is slightly directed backwards. It is rugose on the upperside, emarginated at the apex, and narrowed in front and behind by a transverse impression. The anterior part of the disc which is deeply and irregularly punctured, has a round, deep impression on either side, and in the middle there are two ridges almost smooth forming an oblong cavity, the centre of which is occupied by a raised line deflexed at the apex.

The elytra are not broader than the prothorax at the base, but become broader immediately behind the humeral angles; they are almost plane above, slightly convex and attenuated towards the apex which is abruptly declivous. They are rudely, yet not deeply plicated and each elytron has two rows of tubercles; the first one, placed in the centre of the disc, reaches only the top of the declivity; the tubercles run into one another forming a smooth line from the base to beyond the middle of the disc where they become separated and conspicuous. The tubercles of the second row placed on the edge of the disc are better defined; they are sub-conical, coalesce slightly near the base, and are larger towards the extremity of the elytra where they approach the suture a little above the apex.

The underside is black, and has a few squamose, fuscous markings on the lateral segments of the abdomen and also on the coxae. The legs are moderately long, strong, black, tuberculated all over, the tubercles are setifer; the posterior tibiæ have each two conical curved hook-like spines, the basal one is the largest of the two.

From Namaqualand.

Variety: NANUS.

Long. 12-15m. m. lat 8-12m. m.

The rostrum and prothorax are like those of the type, but less deeply punctured and the lateral spines are smaller. It is in the sculpturing of the elytra that it mostly differs. They are much more convex above, the discoidal row has eight tubercles, the first, second and third basal ones alone coalesce, the others are stronger and well-defined, larger near the declivity, and larger though less conical than those of the outer line. The size of those tubercles is subject to some variation being very obtuse in some specimens. The suture in a male in my collection shows signs of rounded tubercles. The legs are like those in the type, the two spines are very small.

The convexity of the elytra, the difference in the shape of the tubercles and the smaller size made me for a long time doubtful of it being a variety, but I was later on able to examine a larger specimen which united the type with this variety.

The insect is however sufficiently distinct to be known under the name of *B. speciosus* var. *nanus*.

From Worcester and Triangle Station, Cape Colony.

In the Collection of the South-African Museum and in my own.

No. 83.—B. CONSIMILIS (nov. spec.)

Pl. 3 fig. 2.

B. niger, transversus, rostro brevi, lato, supra rugoso, basi arcuato, orbitis elevatis; prothorace utrinque acute spinoso, lineis duabus interruptis in medio carinaque elevatis; elytris, profunde scrobiculatis, ovatis, modice convexis, tuberculis validis duplici serie in singulo instructis.

Long. 22m. m. lat. 12m. m.

The head and rostrum like in the preceding species. The eyes have the same superciliary ridge.

The sides of the prothorax are produced in an acute conical spine slightly directed backwards. It is narrowed in front by a tansverse impression, tuberculated on the disc, and in the middle are two raised and smooth ridges interrupted in the middle and slightly broader in the anterior part, forming an almost parallel cavity occupied in the centre by a smooth and thin ridge.

The elytra are slightly broader at the base than the prothorax, ovate, moderately convex above, declivous towards the apex and each elytron has two series of well defined, sub-conical tubercles. The first series placed in the middle of the disc has twelve tubercles; the two basal ones alone coalesce, the fifth, sixth, and seventh, are strong and well defined, the twelfth reaches a little above the apex; the lateral series is composed of ten conical acute tubercles, the tenth and apical one does not reach any further than the tenth of the first series. The suture has also a few, irregular, very small tubercles on either side.

The legs are deeply punctured and tuberculated; the posterior tibiæ have on the upper outer part three hook-like spines, the basal one longer than the median and the third small.

Although the diagnose of this species agrees much with that of *B. speciosus*, the general facies owing to the ovate form, convexity of body and well defined tubercles is very different. Those two insects are nevertheless closely allied. The only specimen of *B. consimilis* I possess, has lost its fulvous coating on the upper side, but retains some faint marks of it on the underside.

From Beaufort-West, Cape Colony.

In my Collection.

No. 84.—B. SPINIPES (nov. spec.)

Pl. 3, fig. 4.

B. niger, ovatus, rostro longiusculo, profunde punctato, crasso, supra rugoso, basi arcuato; capite brevi, orbitis elevatis; prothorace utrinque acute spinoso, spinis rectis, supra antice sparse tuberculato, postice callo magno oblongo laevi munito, in dorso lineis duabus elevatis carinulam includentibus munito; elytris supra modice convexis, ovatis, postice leviter retusis, tuberculis validis nitidis duplici serie in singulo instructis.

Long 16$^{m.m.}$ lat. 9$^{m.m.}$

Black, ovate, moderately convex above. The rostrum is moderately long, deeply punctured; it has an arcuated impression in the base separating it from the head which is small and has a superciliary ridge.

The lateral sides of the prothorax are produced in a long straight acute spine. The prothorax is narrowed in front by a transverse impression and emarginated on both sides of the apex. In the posterior part of the disc, between the spine and the medium ridge, there is a raised line produced into a smooth, oblong, shining callosity extending a little beyond the base, and in the middle of the disc are two large smooth raised lines extending from the apex to the base and forming a deep oblong cavity occupied in the centre only by a thin ridge.

The elytra are ovate, elongated, moderately convex, covered with short rounded tubercles almost obsolete, slightly declivous at the apex and each elytron has two series of large conical shining tubercles; the first row in the middle of the disc, has six; the two basal ones are elongated and coalesce slightly, the other four are placed at equal distance from one another, the last one reaches a little above the apex. The outer series has only five tubercles; the humeral one is small, the other four conical and acute, the last one reaches a little below the fourth tubercle of the discoidal line.

The underside is black, punctured, and has a few fuscous squamosities. The legs are strongly tuberculated, massive, the tubercles are setifer. The fore tibiæ have a few irregular spines, and the median and posterior ones, rows of short, conical, setifer, regularly disposed tubercles. Each posterior tibia has one conspicuous, moderately long, hook-like spine.

Although allied to the two preceding species it differs much from them by the sculpturing of the prothorax, the ovate body and the disposition of the tubercles.

From Worcester, Cape Colony.

In my Collection.

No. 85.—B. CRISTATUS (nov. spec.)

Pl. 2. fig. 7.

B. oblongo ovatus, niger, fusco-ochraceo lutosus; rostro basi strangulato, fronte retusa, orbitis valde elevatis; prothorace sub-transverso, lateribus in spinam productis; dorso elevato, in medio carinulato, utrinque cristis duabus tridentatis fascieulosisque antice munito; elytris tuberculis quinquplice serie fasciculisque longis in singulo instructis.

Long. 15$^{m.m.}$ lat. 8$^{m.m.}$

Oblong, black, covered with fuscous-brown squamosities. The rostrum is short, very broad at the apex, strongly narrowed at the base; it has a median raised line culminating on the base into a

raised tubercle; the lateral margins are produced in three conspicuous teeth. The head is broader than the rostrum, separated from it by a very deep impression, punctured, and with the superciliary ridges very much raised.

The prothorax is short, sub-parallel, strongly emarginated at the apex, deeply punctured and tuberculated on the sides which are produced in a semi-acute spine; the disc is much raised and ridged in the centre; on each side are two three-dentate transverse tubercles placed at a short distance from one another, and forming two conspicuous crests, and with a fascicle of long brownish hairs in front of the apical crests.

The elytra are oblong, slightly declivous at the apex, deeply punctured, each elytron has five series of raised, sub-conical, tubercles. The first, third and fifth series are the most raised and the basal tubercle of the latter very conspicuous. From the interstices between the series of tubercles spring bunches of long brownish hair which are longer towards the posterior part of the elytra.

Tne underside is covered with light squamosities.

Allied to *B. fasciculosus*, Germar.

From British Caffraria.

In my Collection.

No. 86.—B. NUDUS (nov. spec.)

Plate 3. Fig. 3.

B. oblongus, fere parallelus, niger, sub-nitidus; rostro longo, apice triangulari, postice modice convexo, punctato, basi a capite impressione arcuata disjuncto; capite parvo, punctato; prothorace scrobiculato, antice leviter emarginato, lateribus in spinam productis, postice attenuato, lineis duabus elevatis crassis carinulam includentibus; elytris fere parallelis, supra modice convexis, postice retusis, plicatis, tuberculis validis duplici serie in singulo instructis.

Long. 20$^{m.}$ lat. 9$^{m.}$

The rostrum is narrow at the base, increasing at the apex where it becomes triangular; the base of the triangle is formed by a little tooth projecting on each side above the place of insertion of the antennæ, plane, with a short raised line on the apex, moderately convex posteriorly, covered with deep round punctures and separated from the head by a deep curved impression; the head is small, deeply punctured, the eyes have a faint superciliary ridge. The antennæ are black, setulose, the upper part of the terminal knob is pale-yellow.

The prothorax is a little lobated above the eyes, and has the anterior outer margins produced gradually in a triangle formed above by four transversal smooth tubercles, the posterior and longest one is strongly acute. It is narrowed immediately behind the spine and has a few tubercles and some deep punctures. The middle of the disc is occupied by two thick, much raised lines extending from the apex to a very

short distance from the base and forming a wide oblong and smooth impression, the centre of which is occupied by a small ridge which reaches to the very base and therefore a little further than the two median lines.

The elytra are not much broader than the prothorax at the base; almost parallel, strongly retuse at the apex and slightly convex above. The suture is raised and shining, and each elytron has a double series of strong conical shining tubercles. The interstices between the suture and the first discoidal row has a small raised line with a row of punctures on either side; the second interstice is very roughly plicated. The discoidal series is composed of ten tubercles, the basal one large and rounded, the apical three, long, strong and conical; that series reaches only the top of the declivity. The lateral row reaches to a short distance, from the apical margin and contains eight strong conical tubercles, the humeral one very large and nearly horizontal.

The legs are moderately long, thick, black, granulated, and the tibiæ dotted inwardly with short bristles.

This species is the only one I have met with, showing no sign of squamosities.

From Kenhardt, Cape Colony.

In my Collection.

No. 87.—B. ROTUNDATUS (nov. spec.)

Pl. 2, fig. 6.

B. niger, ovatus, supra convexissimus, creberrime granulatus, squamis cinereis tectus; rostro longo, apice carinulato, convexo, a capite impressione lata arcuata disjuncto; capite magno, laevi, oculis supercilio parvo antice munitis; prothorace rotundato, antice emarginato, creberrime punctato, interstitiis verrucosis; elytris late rotundatis, tuberculis minutis setiferis tectis.

Long. 17$^{m.\ m.}$ lat. 11$^{m,\ m.}$

Black, much rounded and covered with ashy-grey squamosities. The rostrum is long, curved, with two diagonal lines beginning on the outer apical side forming a triangle, the centre of which is occupied by a thin ridge; it tapers slightly towards the base, and has a few impressions hidden by greyish squamosities. It is separated from the head by a deep sub-triangular impression. The head is moderately large, slightly convex; the eyes are depressed, and have in front a small superciliary ridge.

The prothorax is almost round, very convex, and has deep punctures forming small tubercles denuded at the top. There is a faint impression on the anterior part of the disc, the centre of which is occupied by some raised, blunt, coalescing tubercles.

The elytra are broader than the prothorax, much rounded and convex above, declivous at the apex, the declivity overhanging the apical margin. They are covered with deep impressions, the interstices of

which form short setifer, denuded at the top tubercles. On each side of the base, and at a short distance from the suture, there is a callus formed by larger tubercles, and also another small one above the humeral angles, which are very much rounded.

From the Zambezi and Damaraland.

In the Collection of the South-African Museum, and in my own.

Tribe: BYRSOPSIDÆ.

Group: Rhytirrhinidæ. Lacord.

Gen. SYNTHOCUS, Schönherr.

No. 88.—S. PARADOXUS (nov. spec.)

Pl. 3. fig. 5 5a.

S. triangularis, niger, indumento albido-ochraceo tectus; rostro arcuato, setis rigidis obsito; capite parvo, callis supra oculis alte elevatis; prothorace sub-lineari, antice magis acuminato, vertice bi-cristato, medio canaliculato; elytris triangulis, retrorsum abrupte truncatis, supra planis, in medio profunde triangulariter impressis, marginibus disci declivitatisque spinosis, fascia triangula in dorso brunea.

Long. 10-13$^{m.\ m.}$, lat. 6-8$^{m.\ m}$ at the apex.

The rostrum is twice the length of the head, long, abruptly curved downwards towards the apex, slightly canaliculated in the middle, and with a row of rigid bristles on each side. The head is small, coarsely punctured, and has two highly raised and acute superciliary ridges.

The prothorax is coarsely punctured, nearly straight, slightly convex above, strongly emarginated in front; the outer margins are strongly acuminate, the point reaching beyond the eye. On the disc are four raised lines; the two median ones form a groove occupied in the centre by a small ridge; they are dotted with a row of rigid bristles longer in the median lines which are also more raised. Those four lines coalesce at the apex where they form an elevated crest-like lobe divided in two by the median groove.

The elytra are transversally plicated; they are not broader than the prothorax at the base, produced gradually into a triangle, twice as broad at the apex than at the base, plane above, cut at right angle at the declivity; the dorsal margins are slightly raised, the suture is very obsolete and the middle of the disc is occupied by a deep common triangular impression; on each side of the impression are three sinuated,

slightly raised lines, the second one alone reaches the base of the dorsal triangle and meeting there the lateral margin develops itself into a callus produced beyond the declivity and overhanging it. The dorsal outer margin is dotted to the end of the declivity with strong spines and in the middle of the declivity itself there are two raised lines dotted with rigid bristles and with a strong spine on either side of the base of the suture which there alone is noticeable.

The prothorax and the disc of the elytra are covered with a greyish white coating; the median groove of the prothorax and the triangular impression of the elytra are of a light brown colour and the underside is slightly fuscous.

The legs are thick, massive and dotted with short rigid bristles.

Captured near Cape Town.

In the Collection of the South-African Museum and in my own.

No. 89.—S. PLAGOSUS (nov. spec.)

S. quadratus, niger, indumento fusco nigroque variegatus; prothorace lato, sub-transverso, supra sub-plano, tricanaliculato; elytris amplis, quadratis, postice valde retusis, supra planis, tuberculis validis triplici serie in singulo instructis; fascia triangulari in dorso, alteraque posticali nigris.

Long. 15m.m. lat. 9m.m.

The rostrum is moderately long, slightly curved at the apex, narrowed near the base, convex above, and covered with greyish and black scales; the head is small and has greatly developed superciliary ridges. The antennae are short, black, and slightly setulose.

The prothorax is sub-transverse, strongly emarginated near the eyes, and has on each side a deep impression and a transverse hollow line; it is almost plane above and has three grooves formed by four raised lines; the lateral ones have a small callus in the centre, the two median ones are somewhat tuberculated; they have also a few bristles and form a groove deeper than the lateral ones. The interstice between the lateral and median line is coated on each side with black squamosities.

The elytra are broader than the prothorax, quadrate, abruptly truncated at the apex; each elytron has three series of tubercles, the first and second series from the suture reach only the top of the declivity where they coalesce, the lateral one which alone reaches the apex begins at the base in a double series of tubercles. On the declivity, and close to the suture are two series of smaller tubercles beginning at the vertex a little below the first dorsal series. The interstices are deeply punctured. Like the prothorax, the elytra are covered with dense fuscous squamosities, and they have also a large triangular, glossy-black patch on the disc beginning on each side of the suture at the base, reaching diagonally the lateral margin and extending in a straight line across the elytra leaving the third posterior part of the disc and also an elongated yellow spot near the scutellary region covered with very dense pale yellow scales; beside

the discoidal patch, there is another longitudinal one of the same texture on the declivity.

The underside and legs are covered with a greyish coating, the latter are massive and dotted with short bristles.

From Beaufort West, Cape Colony.

In my Collection.

No. 90.—S. SAGITTARIUS (nov. spec.)

S. quadratus, niger, robustus, squamulis nigris albidis fuscisque dense tectus; rostro longiusculo, apice leviter curvato, basi constricto, a fronte carinula triangulari disjuncto, capite rostro latiore, superciliis altis; prothorace sub-transverso, apice valde lobato, medio lateribusque canaliculatis grosse punctato, interstitio laterali nigro; elytris quadratis, apice valde retusis, supra planis, tuberculis quinquplice serie in singulo instructis, plaga longitudinali nigra, alteraque diagonali fusca in medio ornatis.

Long. 10-12m. m. lat. 7-9m. m.

The rostrum is moderately long, slightly curved at the apex, narrowed at the base, the outer margin is sinuated, and it is separated from the head by a triangular raised line; the head is large, and has an impression on either side formed by the highly raised superciliary ridge. Both head and rostrum are covered with fulvous squamosities, and they have also a few short bristles.

The prothorax is nearly transverse, narrowed at the apex by a deep impression, the lateral sides are strongly acuminated anteriorly. On the disc are four raised, slightly convex lines forming three grooves, the median one is the deepest; those four lines coalesce at the apex and form a short blunt crest on either side of the median groove. It is deeply punctured and covered with dense greyish squamosities, fuscous on the raised lines and black in the lateral grooves.

The elytra are broader than the prothorax, acutely angular on the shoulders, parallel, abruptly truncated at the apex, and each with three long discoidal series, and two basal ones of acute tubercles with small interstices. The first series from the suture composed of tubercles nearly obsolete at the base, and more developed posteriorly, reaches the apex; the second reaches only the third part of the disc; the third, beginning at a little distance from the base, has well defined tubercles, sharper near the top of the declivity where it ceases; the fourth is merely an elongated basal tubercle; the fifth, formed by very acute tubercles, descends the declivity and does not quite reach the apex. The interstices between the first and third series, and also the fourth basal callus, are black, and from the scutellary region extends on either side a diagonal, broad, fuscous band, shaped like a broad-arrow, the basal points of which reach a little short of the declivity. The remainder of the body is densely coated with whitish squamosities turning to light-fulvous in some specimens.

The legs are strong, short, and have the apical part of the femora and the whole tibiæ black and dotted with a few white scales. The tarsi are black, long, and very thick.

From Damaraland.

Allied to *S. nigro-pictus*. Pascoe. The preceding and following species, the present one, and the two insects described by Mr. Pascoe – Journ. Lin. Soc. vol x—form, as far as is now known, an homologous group in that very polymorphic family.

No. 91.—S. SORDIDUS (nov. spec.)

S. sub-ovatus, robustus, niger, squamulis fuscis terrenisque tectus; rostro longiusculo, apice leviter curvato, basi constricto; capite lato, in medio carinulato, superciliis elevatis; prothorace sub-transverso, apice late emarginato, in medio canuliculato; elytris fere sub-ovatis, postice valde retusis, supra fere planis, tuberculis obtusis quinquplice serie in singulo instructis plagaque communi elongata terreno-nigra in medio disci ornatis.

Long. 13$^{m.\ m.}$ lat. 9$^{m.\ m.}$

The rostrum is moderately long, slightly curved at the apex, with the sides lobated, and narrowed at the apex. The head is large, and has a raised line in centre, the superciliary ridges are very prominent. Both head and rostrum are densely covered with scales, and have besides a few short bristles.

The prothorax is sub-transverse, narrowed in front by a deep impression, the apical lobes are very acute. It is almost plane on the disc; rudely punctured, and has a deep median groove; there is also another very obsolete groove on each side; it is densely covered with greyish brown squamosities turning to dirty black on the disc.

The elytra are much broader than the prothorax at the base, and with the humeral angles slightly rounded, sub-ovate, plane above, strongly retuse at the apex and each with five series of porifer rather blunt tubercles, with the interstices deeply punctured. The first series from the suture reaches to a short distance from the apex, the second and fourth stop at the top of the declivity, the tubercles are larger on the third series which reaches a little further than either the second or fourth, the fifth series alone comes close to the apex. The interstices between the first four lines and also the tubercles are covered from the base to the top of the declivity with dirty-black scales, the rest of the body with a light brown squamosity.

The legs are strong, massive; the apex of the femora and the whole tibiae are black, with a few whitish squamosities and also a few short bristles. The tarsi are black, long and thick.

It resembles much the preceding species, but it is more ovate, the disposition of the tuberculated lines is different, the sides of the disc are less perpendicular and exhibit faint signs of raised lines.

From Damaraland.

In my Collection.

Tribe: SOMATODIDÆ, Lacord.

Genus: SOMATODES, Schönherr.

No. 92.—S. BI-DENTATUS (nov. spec).

S. oblongus, niger, squamulis cinereis variegatus; rostro brevissimo, supra carinula abbreviata instructo; prothorace rotundato, in medio depresso, leviter canaliculato, undique tuberculis setiferis instructo; elytris sulcatis, interstitiis tuberculatis, singulo ante apicem spina valida conica armato, margineque laterali tuberculo apicali valido, obtuso.

Long. 19m. m. lat. 9m. m.

Black, irregularly covered with greyish scales more abundant on the elytra.

The head is very short, black; the rostrum is not longer than the head, and separated from it by a transverse impression; it is very thick, short and has a small raised line in the centre.

The prothorax is broader than long, slightly emarginated in front, with the outer margins much rounded; it is almost plane on the disc, and covered with setifer round tubercles more abundant and larger on the sides; in the middle of the disc there is a very faint groove with a large elongated tubercle in the centre, and two deep impressions on the posterior part.

The elytra are slightly broader than the base of the prothorax, almost parallel, rounded at the apex, more than twice the length of the prothorax, slightly convex above, and each with three rows of acute tubercles, nearly obsolete in the anterior part of the disc, but strongly developed in the posterior part. The first line ends in a conspicuous long spine a little before the apex. The interstices are rugose, and the lateral margin has on each side of the suture an obtuse, large, shining tubercle.

The under side is black; the legs are slightly tomentose.

Captured on Table Mountain.

In my collection.

Gen. ONCYLOTRACHELUS, Schönherr.

No. 93.—O. PUNCTIFRONS (nov. spec.)

S. oblongus, convexus, squamis fuscis tectus; rostro brevi, supra carinula punctoque magno instructo; prothorace rotundato, depresso, supra confertim granulato; elytris convexis, ampliatis, in medio sulcatis, linsis sex elevatis in singulo instructis.

Long. 17m. m. lat. 5m. m.

The head is short, closely punctured, the punctures filled with short brownish hairs; it has a faint hollow line in the apex, and is separated from the rostrum by a deep impression. The rostrum is a little longer than the head, thick, massive, grooved in the middle; the eyes are round.

The prothorax is broader than long, covered with short tubercles, and has no trace of canaliculation in the centre; it is narrowed and rounded at the anterior angles, and has a deep impression extending along the basal margin.

The elytra are three times the length of the prothorax, not much broader at the base, wider in the middle, very convex and slightly declivous at the apex. They have each six raised shining lines; the first one reaches the apex, the second joins the lateral margin, the third, fourth, fifth, and sixth reach only the point of the triangle formed by the junction of the second line with the lateral margin, which is raised towards the middle. The suture is also raised and shining. The interstices between the raised lines are filled with a fuscous substance, which partly hides some very short tubercles.

The underside is black, moderately shining, and covered with short greyish setae. The legs have some short bristles, somewhat longer and brownish near the apex of the tibiae.

From Rustenberg, Transvaal.

In my Collection.

Tribe: HIPPORHINIDÆ, Lacord.

Gen. HIPPORRHINUS, Schönherr.

No. 94.—H. TRANSVAALENSIS (nov. spec.)

H. oblongus, niger, indumento cinereo-albido vestitus; rostro sulcato; prothorace transverso, lateribus leviter ampliatis, tuberculis sub-cylindricis seriatim obsito, in medio leviter canaliculato; elytris costis quatuor tuberculatis in singulo instructis, interstitiis, primo a sutura excepto, squamis argenteis tectis.

Long. 30m. m. lat. 12m. m.

The head is large, slightly convex, punctured, black, opaque and has a few minute hairs; it is canaliculated towards the base of the rostrum, which is twice as long as the head, thick, angular, deeply canaliculated above, and with a small, not much developed, groove on each side, slightly punctured and dotted with a few brownish hairs. The antennae are black and hairy.

The prothorax is short, transverse, very slightly broader on the sides, almost plane above and without any lateral spines; the disc has two rows of black, rounded tubercles on each side leaving a cavity in the centre of which stands a solitary elongated tubercle. The space between the rows of tubercles is deeply coated with white silvery scales forming five conspicuous longitudinal bands. The underside of the prothorax is coated with ashy-white scales.

The elytra are three times the length of the prothorax, sub-parallel, broader than the prothorax at the base, slightly convex and ending at the apex in two sharp, long spines. They have each four raised lines of rounded setifer tubercles. The first one, close to the suture is almost obsolete; the second one is composed of a double series of closely set tubercles down to the declivity from which point the outer series runs singly and reaches the apex; the third line made of a double series of tubercles reaches only the declivity; the fourth consists of three series, the second and third are shorter than the first which alone reaches the apex. The space between the first lines of tubercles on each side of the suture is coated with a brown substance, the second and third interstices and also the lateral margins are covered with silvery-white, somewhat opaline scales. The underside is black with a few short brownish hairs and also a few scales. The legs are moderately long, black, hairy, and have long black bristles inwards.

Allied to *H. sex-vittatus* from which it differs widely by the form of the prothorax, by the rostrum much more deeply grooved, by the disposition of the four rows and by the general facies which is much more massive.

From Leydenberg, Transvaal.

In the Collection of the South-African Musuem.

Tribe: ALCIDIDAE, Lacord.

Gen. ALCIDES, Schönherr.

No. 95.—A. GLANVILLEI (nov. spec.)

Oblongo-ovatus, gibbus, olivaceus, lateribus prothoracis subtusque albido-squamosis; rostro crassiusculo, longitudine thoracis; prothorace tuberculis magnis depressis obsito, elytris foveolatis, callo humerali, fascia minuta triangula punctoque parvo apicali, albido-tomentosis; pedibus anticis elongatis, femoribus tibriisque dentatis.

Long. (rost. excl.) 12-13$^{m.\ m.}$ lat. 7-8$^{m.\ m.}$

The rostrum is the length of the prothorax, moderately thick and black; the antennae are also black with the knob pubescent and greyish.

The prothorax is a little broader than long, depressed at the apex, very sinuated on either side at the base, moderately convex above, and covered with large rounded tubercles leaving a distinct impressed longitudinal line in the centre culminating in a deep fovea above the scutellum. The interstices of the disc, the outer margins and the whole underside are filled with a fuscous pubescence which turns to reddish in the postical fovea. The scutellum is small.

The elytra are broader than the prothorax at the base, the humeral angles are very developed, pointed, and impressed transversely behind; they are very convex above, gibbose, much attenuated and declivous at the apex. Each elytron has eight raised lines, the interstices are very deeply foveolated, they are of dark-olive colour like the prothorax, and have one white squamose dot on the humerus, a small triangular patch on the second, third and fourth interstice, a little beyond the middle of the disc, and immediately below, a very small dot of the same substance on the fifth line.

The underside is densely covered with fulvous squamosities. The anterior legs are long, the femora toothed on the centre, the tibiae with one sharp tooth in the middle and two at the internal apex.

From Kowie, Cape Colony.

Three specimens of this fine insect were sent to me by Miss Glanville, the Curator of the Albany Museum, after whom I propose to name it.

Family: LONGICORNIA.

Sub-family: Prionidae.

Tribe: Cacoscelidae, Lacord.

Genus: CACOSCELES, Newman.

No. 96.—C. ŒDIPUS, Newman.

Plate 4 fig. 2 mas.
,, 4 fig. 1 fem.

The sexual characters of this insect are so dissimilar that it is easy to understand the mistake made by Professor Lacordaire in his *Genera des Coléopterès*, who in his diagnosis of the genus assigns to the female, "mandibles a little shorter and more regularly arcuated than those in the male," whereas they are strikingly different, and the fact of his saying that the four posterior tibiae are "*également dilatés*," leads me to believe that his diagnose of the female applies to a small male of an aberrant type.

C. Oedipus, female, differs from the male in the shape of the mandibles which are not longer than the head, and do not enclose an open space, they are besides very much thicker, the right one has a small basal tooth, the left an apical well developed one. The antennae are shorter than the male's, the articles 6-10 less serrated at the apex. Prothorax like in male, the upper part of the disc has two rounded prominences with a more or less distinct impression immediately in front. The posterior tibiæ are arcuated but do not exhibit any trace of the dilatation and tomentose groove so peculiar in the male. The elytra are less accuminated at the apex.

The male insect varies much in size. The largest I have seen is 0·54$^{m.\,m.}$ in length, the smaller 35$^{m.\,m.}$; the female is from 57 to 48$^{m.\,m.}$ in length.

The figure of *C. Oedipus*, given in Lacordaire's above mentioned work, is very defective in the rendering of the mandibles, the shape of which somewhat resembles those of an aberrant form of my *C. crassicornis*, but differs in having the antennae but little serrated.

The habitat of this Cacosceles, which I take to be the *C. Oedipus* Newman, seems to be restricted to the Cape Colony proper. I have seen specimens of both sexes captured at Hex River, George, Knysna, Kowie, Graham's Town and Prieska near the Orange River.

In the Collection of the South-African Museum and in my own.

No. 97.—C. CRASSICORNIS. (nov. spec.)

Pl. 4 fig. 4 mas.
4. fig. 3 fem.

C. mas elongatus, niger supra glaber, mandibulis longis, falcatis, antennis crassis, valde serratis, medium elytrorum paullo excedentibus; elytris ferruginois, leviter ruguloso-punctatis.

Femina a mare differt mandibulis brevioribus, crassis, antennis modice serratis, tibiis posticis nonnihil canaliculatis.

Long. (mand. excl.) 28-42$^{m.\,m.}$ lat. 10-15$^{m.\,m.}$

Male. The head is black, sub-quadrate, punctured in front, somewhat plicated behind, and has a longitudinal impression in the centre; the mandibles are very long, falcate, varying much in length, being as much as 15 millimetres long in the largest specimens, but in all cases longer or as long as the head and circumscribing an empty space; they are slightly toothed at the base and the left one is strongly bifid at the apex. The antennae reach to a little beyond the middle of the elytra; the articles are short, very thick and very strongly serrated at the apex. The prothorax is very rugose, fringed at the apex and base with yellowish hair, the outer margin is three-dentate, the median tooth is the longest of the three; in the centre of the disc are two callosities and a very faint longitudinal depression in the middle. The elytra are fulvous, attenuated at the apex, with the shoulders well

developed; they are moderately convex, slightly rugose and on each one are three very faint longitudinal raised lines, which are hardly discernible in some specimens.

The underside is black, the pectus and apical middle part of the abdominal segments covered with short brownish hair. The median and posterior tibiae are much inflated in the centre and have a deep cavity in the inner part filled with short brown hair.

The shape of the mandibles varies much; in small specimens, their length is only 4 millimetres, and in those, the left mandible has three distinct teeth besides the apical one which is always the longest.

The female differs from the male by the shape of the mandibles which are short, massive, not longer than the head, and the edges of which fit closely. The antennae are shorter, less massive, the elytra are less convex, and not so much attenuated at the apex; the posterior legs are not dilated or grooved, the pectus and abdominal segments are destitute of hair. The sculpturing of the prothorax varies much, the centre of the disc exhibits sometimes two callus as in the male, sometimes merely a transverse impression, and the longitudinal lines of the elytra are generally more conspicuous.

Allied to *C. Oedipus*, Newman, but it will be easily distinguished from it by the less robust facies, and by the peculiar shape of the antennae.

The habitat of that species, of which I have seen no less than 14 specimens, seems to be restricted to the Northern and Western parts of the Transvaal.

From the Zambeze, and Rustenberg, Transvaal.

In the Collection of the South-African Museum and in my own.

The figure of the male, pl. 4 fig. 4 should have the bifid left mandible overlapping the right one.

Tribe: PHORACANTHIDÆ, Lacord.

Gen. CORDYLOMERA, Serville.

No. 98.—C. ZAMBEZIANA (nov. spec).

C. elongata, sub-depressa, rufo-testacea; capite prothoraceque rufo-tomentosis, sub-nitidis; elytris fulvis, glabris, creberrime punctatis.

Long. 14-16 m. m. lat. 3-3½ m. m.

The head is small, punctured, the frontal part divided by a transverse raised line. The eyes are large and granulated. The antennæ

are longer than the elytra by one half in the male, and very little longer in the female; they have small setæ underneath, and the articles 3 to 5 are armed with a sharp spine at the apex.

The deeply punctured prothorax is narrowed at both base and apex, rounded in the middle, almost plane, and with four obsolete tubercles on the disc. It is of a dull, semi-opaque red and covered with very fine tomentosity.

The elytra are of a lighter hue than the prothorax, deeply punctured, parallel, four times the length of the prothorax, a little broader at the base and with the shoulders well developed; they taper slightly towards the apex, and are produced in a long, sharp spine. Each elytron has three small longitudinal lines, two running parallel with the suture; the third one beginning at the humeral angle runs with the margin; those three lines become very faint before reaching the apex.

The legs are elongated, the femora very strongly pedunculated; the underside and legs are covered with a silky villosity.

From the Zambeze River, Leydenberg and Rustenberg, Transvaal.

In the Collection of the South African Museum and in my own.

Group: Tragocephalidae, Lacord.

Gen. TRAGOCEPHALA, Castelnau.

No. 99.—T. BRADSHAWI (nov. spec.).

I. oblonga, atra, holosericea; fronte, prothoracis lateribus plagaque postical in disco, sulphureo-tomentosis; elytris plaga cordiformi communi medium basi occupante; plaga transversali pone humeros arcuata, fascia mediana ramulum emittente, punctis duobus albis, plagaque intra apicali sulphureo tomentosis, hac coccinea, in singulo ornatis.

Long 19·20$^{m.m.}$ lat. 6·6½$^{m.m.}$

The head hardly narrower than the prothorax and with a longitudinal line on the vertex, is black, with the forehead covered with a sulphur yellow tomentosity and has a yellowish white band extending transversely along the cheeks, and a small yellow patch behind the antennifer tubercles.

The prothorax is a little narrowed in front, acutely turberculated on the sides posteriorly, narrowed at the base immediately behind the tubercles, moderately convex above, and has a transverse impression near the apex and another deeper near the base which is bi-sinuated.

The outer sides have a broad sulphur-yellow band, but the apex of the tubercles is denuded; in the posterior part of the disc is an obtusely triangular sulphur yellow patch which reaches from the base to a little beyond the postical basal impression. The scutellum is semi-circular and black.

The elytra are parallel, moderately convex above, and rounded at the apex. Immediately below the scutellum there is a large cordiform median patch extending equally on both elytra; below it, on each elytron is a transverse band arcuated near the shoulders and not connected with the median patch; beyond the middle of the disc, there is another transverse band much sinuated near the suture, the sinuation pointing backwards, and also an intra-apical patch. These bands are sulphur yellow, with the exception of the intra-apical patch which is decidedly reddish-purple. Between the posterior band and the intra-apical patch there are two white spots and the apical margin close to the suture is also white.

The underside is black and shining, the sides of the pectus and abdominal segments are dotted with blueish-white tomentosity, the legs are also tomentose, blueish-white, the coxae annulated in the middle.

Captured on the Zambeze River by Dr. Bradshaw.

In the Collection of the South-African Museum.

Gen. TRAGISCOCHEMA, Thomson.

No. 100.—T. APICALIS (nov. spec.)

Pl. 4 fig. 6.

T. oblonga, linearis, nigra, tenuiter pubescens; fronte prothoraceque vittis quatuor et parte antica elytrorum, sulphureo tomentosis, lateribus abdominis punctis quatuor albidis notatis.

Long. 13$^{m.\ m.}$ lat. 4$^{m.\ m.}$

The head is as broad as the prothorax. The forehead has a transverse denuded line between the antennifer tubercles and is covered with a tomentose sulphur-yellow coating disposed on the vertex in four broad lines which are continued on the prothorax as far as the base. The space between those lines is black and silky; in the middle of the forehead there is an almost obsolete vertical impression. The antennae are black, one-half longer than the body in the male, and reaching only the apex of the elytra in the female.

The prothorax is nearly as broad as long, convex above, slightly more attenuated in front than behind; the sides are slightly rounded, broader in the middle and hardly produced into a spine; it is deeply impressed transversely near the base, and in a lesser degree in the apex. The scutellum is black, semi-circular

The elytra are linear, three times the length of the prothorax, rounded at the apex, but not narrower there than at the base, and moderately convex. They are covered from the base to two-thirds of their length with a sulphur-yellow tomentose coating sinuated at the end, the apical third is black and silky.

The legs are black, the anterior femora have each a whitish dot on the upper part. The underside is black, shining and slightly villose. The first four segments of the abdomen have on each side a white spot smaller in the basal segment and entirely wanting in the apical one. There is also a white patch in front of the anterior coxae.

From the Zambezi River and also from Rustenberg, Transvaal.

In the Collection of the South-African Museum and in my own.

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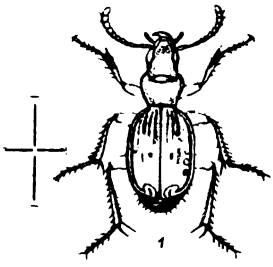
98. Cordylomera Zambeziana.
99. Tragocephala Bradshawi.
100. Tragiscochema apicalis.

Pl. 1.



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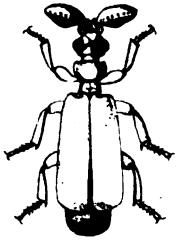

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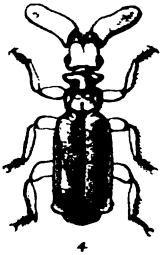

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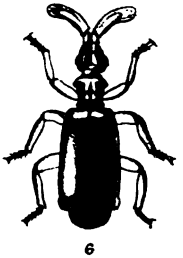

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J.Migneaux del.

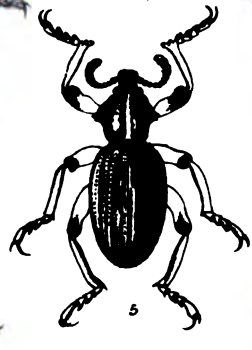
West,Newman & Co lith.

Plate 1:—

Fig. 1.—Piezia ..	..	*albosignata* ..	Peringuey.
,, 2.—Pausus ..	..	*cylindricornis* ..	Do.
,, 3.— Do. ..	..	*rusticus*	Do.
,, 4.— Do. ..	..	*signatipennis* ..	Do.
,, 5.— Do. ..	..	*Ayresi*	Do.
,, 6.— Do. ..	..	*novaculatus* ..	Do.
,, 7.—Ischnostoma ..	..	*picta*	Do.
,, 8.—Julodis ..	..	*gariepina* ..	Do.

Plate 2:—

Fig. 1.—Brachycerus	..	*impressicollis*	.. Peringuey.
,, 1A.— Do.	..	seen sideways.	
,, 2.— Do.	..	*lobaticollis*	.. Do.
,, 3.— Do.	..	*tursio* ..	.. Pascoe.
,, 4.— Do.	..	*squamosus*	.. Peringuey.
,, 5.— Do.	..	*albotectus*	.. Do.
,, 6.— Do.	..	*rotundatus*	.. Do.
,, 7.— Do.	..	*cristatus*	.. Do.



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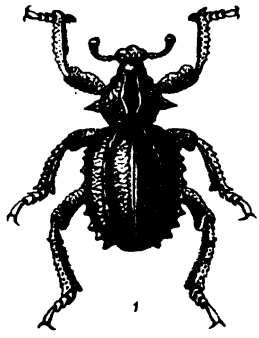
Pl. 3.



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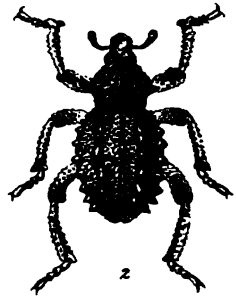

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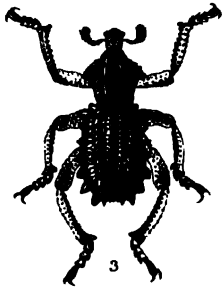

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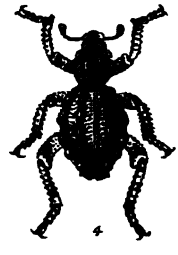

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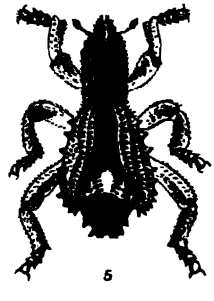

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J.Mignoeaux del

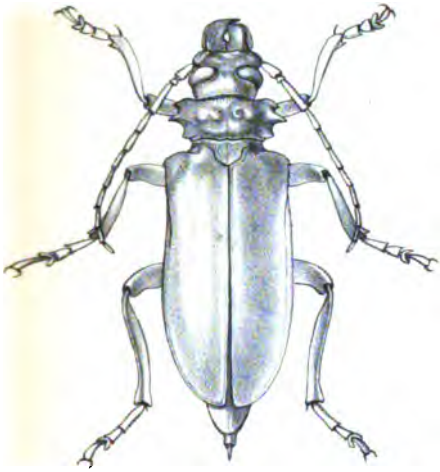
West, Newman & Co. lith

Plate 3:

Fig. 1.—Brachycerus	.. *speciosus*	..	Peringuey.
,, 2.— Do.	.. *consimilis*	..	Do.
,, 3.— Do.	.. *nudus* ..	..	Do.
,, 4.— Do.	.. *spinipes*	..	Do.
,, 5.—Synthocus	.. *paradoxus*	..	Do.
,, 6.— Do.	.. *do.*	..	Seen sideways.

Plate 4:—

Fig. 1.—Cacosceles	..	*Œdipus*	.	Newman	.. Fem.
,, 2.— Do.	..	*do.*	..	..	.. Mas.
,, 3.— Do.	..	*crassicornis*	..	Peringuey...	Fem.
,, 4.— Do.	..	*do.*	..	..	.. Mas.
,, 5.—Anomalipus	..	*Decosteri*	..	Peringuey.	
,, 6.—Tragiscochema..		*apicalis*		Do.	



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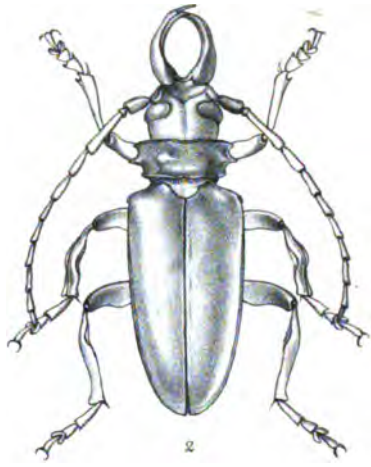

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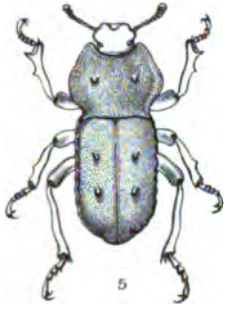

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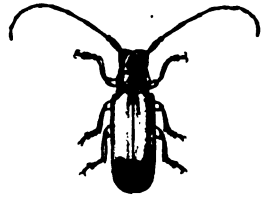

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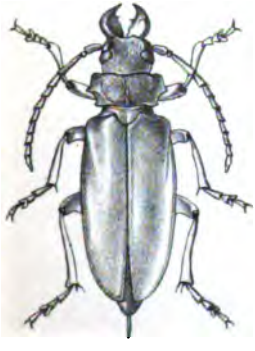

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J. Migneaux del.

West Newman & Co lith.

CATALOGUE

OF

PRINTED BOOKS AND PAPERS

RELATING TO

SOUTH AFRICA.

PART II.

CLIMATE AND METEOROLOGY.

COMPILED BY

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M.A., M.INST.C.E., F.R.MET.S.,

HYDRAULIC ENGINEER TO THE CAPE COLONY.

W. A. RICHARDS & SONS, PRINTERS, CASTLE-STREET, CAPE TOWN.

1885.

PREFACE.

The area of the Earth's surface included in South Africa for the purposes of this Catalogue is considered as bounded more or less by the parallel of twenty degrees South latitude. Thus Damaraland, the Kalihari, Bechuanaland, Shoshong, the Makalakas, the Transvaal, Umzila's, the Gasa country, and Sofala, are included. Lake Ngami, all the tributaries of the Limpopo and Sabia are included, but not the Zambesi or its tributaries. The islands Madagascar, Mauritius, Réunion and St. Helena are not included.

The compiler does not claim that this Catalogue is by any means exhaustive. It would, however, have been very much more complete had the S. African Public Library not been so sadly deficient, especially in the publications of Scientific Societies.

The compiler has not been able to verify all references.

Notices of climate casually made in books of travels are not included, unless either scientifically expressed or of special interest.

The temperature of the sea being closely connected with the weather, publications dealing with that subject have been included.

The newspapers of S. Africa frequently contain Meteorological Observations, but it has not been found practicable or thought necessary to attempt to include all of these.

The compiler will be glad to receive notice of corrections and additions.

Note.—When months are quoted thus, Jan.-Feb., in all cases both months are included.

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CLIMATE AND METEOROLOGY.

EXPLANATION OF SIGNS AND ABBREVIATIONS.

A.: Africa; Ad.: Admiralty.

B.T.: Board of Trade; Bar.: Barometer.

C.: Cape; C.G.H.: Cape of Good Hope; C.M.: Cape Monthly; C.Q.: Cape Quarterly; Clim.: Climate; Col.: Colony or Colonial.

Erdk.: Erdkunde.

Inst.: Institution.

Met.: Meteorology or Meteorological; Mit.: Mittheilungen.

Obs.: Observations.

Pet.: Petermann; Proc.: Proceedings; P.L.: South African Public Library.

Q.: Quarterly.

R.: Royal; R.E.: Royal Engineers.

S.: Society and South; S.A.: South Africa.

Temp.: Temperature.

Z.: Zeitschrift, also Zuid; Z. ö. G.: Zeitschrift der Oesterreichischen Gesellschaf für Meteorologie; Z.A.: Zuid Afrika.

CATALOGUE OF PRINTED BOOKS AND PAPERS RELATING TO SOUTH AFRICA.

NAME.	SUBJECT.	TITLE OF WORK.	REFERENCE.
Adamson, *D.D.*	"General."	Met. Com. Rep. S.A.Q.J.	Vol. II. No. 5, p. 105.
	"Self-registering Thermometer."		
Alston, *Garwood*	"Met. data."	C.M., 2 ser., C.Q., P.L.	VII. 31, 183.
	"Clim. of N.W."		I. 544; II. 135, 312.
Anderson, *A. A.*	"Climate of Kalihari "Zouga sometimes flows into, sometimes out of Ngami, according to the rainfall."	R.G.S.J., 1884.	p. 19.
Andersson, *Chas. John*	"Clim. of Ondonga. Temp. Ovampoland."	Travel in S.A. Ed. L. Lloyd, Lond, '75.	225, 286, sqq.
	"At *Richterveldt*, inland from Walvisch B. Every afternoon at 2 p.m. we had strong breeze from W."	Lake Ngami, numerous illust., '56.	93.
	"At *Schleppmansdorf*, less than 20 m. from sea, almost always a refreshing breeze, thermometer for many days rose above 110°."	"	
	"First showers at *Barmen* usually fall as early as Sept. or Oct., but rainy season does not fairly set in till Dec. and Jan."	"	p. 118.
Andrau	"Currents off C.G. H., boundaries of Agulhas and W. coast currents."	Z. d. allg. Erdk.	Vol. VI. 1859.
Arbousset & Dumas	"May-Aug., Maluti Mts. covered with snow. Oct.-March, heavy rains in Basutoland."	Voyage d'exploration au N.E. de la Colonie du C. de B.E., Paris, '42.	p. 135.
Arnott, *Neil*	"Expl. of 'Table Cloth.'"	Physics. Ed. 3. Lond. '28, P.L.	pp. 395, 396.
Backhouse, *Jas.*	"1838, at Enon long drought. 1842, Severe drought in Kaffraria. Mirage."	Mauritius and S.A., 2 maps, 16 etch. Lond. '44, P.L.	pp. 165, 217, 499.
Bain, *A. G.*	"Barolong country."	S.A.Q.J.	Vol. I. p. 417.

NAME.	SUBJECT.	TITLE OF WORK.	REFERENCE.
Baines, *Thos., F.R.G.S.*	"Obs. betw. Limpopo and Zambesi."	Proc. R. Met. S.	V. 52.
	"Rainy season; drying up of Ngami; course of a storm; four inches in one night."	Explor. in S.W. A., Lond. '64.	pp. 176, 262, 267, 268.
	"Climate; heights above sea level: Doorstland between Shoshong and Tati."	Gold Regions of S.A., '77, P.L.	pp. 8, 19, 88.
Barrow, *John*	"Climate about Cape Town."	Travels into Interior of S. Africa, 1797 and 1798, pubd. 1801 and 1805.	Vol. I. 40, 41.
	"At Dwyka River seldom rains; land of desolation."	,,	97.
	"Rains in great mts. beyond Kaffirs and Tambookies commence in November; inundations begin in December,"	,,	296.
	"Hot winds."	,,	326.
	"Karroo impassable through drought; one continued plain of uniform barrenness."	,,	327.
	"Snow in Long Kloof."	,,	334.
	"Instability of S. Af. clim.; snow on longest day in year."	,,	336.
	"Breaking of monsoon."	,,	357.
	"Khamiesberg has rain and snow."	,,	387.
	"Reason of scarcity of springs, though rain is abundant."	,,	Vol. II. 60.
	"Fish River almost dry."	,,	74.
	"Climate healthy."	,,	pp. 164, 240.
	"S.E. winds uncertain."	,,	256.
	"Climate."	,,	pp. 329-332.

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Bates, *H. W., F.R.G.S.*	"General."	Handbook of S. A., Silver.	
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Blencowe, *G.*	"Phys. Geog. of Zululand and borders."	Proc. R.G.S.	1879 ?
Blore, *W., Sec. to Met. Com.*	"General."	Reports of Com.	
	"Experts. on Evapn."	Symon's Mag.	VII. 161.
	"Met."	C.M.	First Series, IV. 174, 177. First Series, VI. 254.
Böhm (Behm)	"Periodicity in rainfall, S.A."	Pet. Mit., P.L.	IV. 200, '58.
Böhm and Bernsmann	"Met. Obs in Hereroland:" very good. "Coast land — no rain." "Second belt hilly; November-May irregular thunderstorms." "Third region, plains; Sept.-May, tolerably regular thunderstorms." "Walfisch Bay—Sept.-Jan., S.E. wind, May-Aug., E."	Pet. Mit., P.L.	XXIV. pp. 306–311, '78.
Bolus, cf. Drege			
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Boulton, *Lieut., R.N.*	"Climate S.W. coast."	Q.J.Met.S.	I. 97. '72, '73.

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Brooks, *Henry*	"Climate of Natal:" good.	History and Description of Natal, edited by Dr. Mann. Reeve & Co., P.L.	Chapter III.
Brown, *Rev. J. Croumbie*	"Climate."	Hydrography of S.A., Lond., 1875. P.L.	Passim.
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Buchan, *Alex.*	"Mean of pressure of atmosphere and prevailing winds over the globe."	Proc. R.S.Edin. Trans.R.S.Edin.	VI. XXV.
,,	"(Mean height of barometer varies in the yearly period, Cape Town, Graaff-Reinet, Maritzburg.) Probable low barometer in summer in Central A."	Z. ö. G.	V. 116.
,,	"Tables of mean temperature and rainfall in S.A."	Z. ö. G.	VII. 204—207. '72.
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Burchell	"Meteorological register on journey. Climate of Colony. Weather at Klaarwater, west of Campbell. Climate of Litakun."	Travels in S.A. Pub. price, £9 9s. Beautiful pictures and good map, and index; vol. I, 1822. Vol. II, 1824.	I. 26, 42, 58, 65, 80, 81, 153, 156, 176, 202, 251, 257, 270, 275, 283, 287, 314, 327, 337, 368, 369, 375, 394, 438, 488, 491, 507, 515, 555-573, II. 127, 235, 236, 259, 299, 317, 353, 465, 527, 601—610.

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Chapman, *Jas., F.R.G.S.*	"Climate."	Proc. R.G.S.	v. I.
	"Climate of Transvaal."	Travels in Interior of S.A. Lond. '68. P.L.	Vol. I. pp. 10, 11.
	"Drying up of L. Ngami and general desiccation"	,,	Vol. I. pp. 203, 242. II. pp. 6, 61, 310.
	"Snowstorm at Sekomi's."	,,	I. 264.
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Cornelissen *J. E., Director of Dutch Met. Institute.*	"Temperature of sea near Cape, with charts."	Pubn. of R. Met. Inst. of Netherlands. Utrecht	1868.
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II. REPORTS AND BLUE BOOKS.

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2. Africa Pilot, pubd. by Ad.
3. Wind and Current Charts of the Atlantic, pubd. by Ad., 1868.
4. Wind and Current Charts for each Quarter of the Year, pubd. by Ad., 1879.
5. Ice Chart of S. Hemisphere, pubd. by Ad.
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9. Abstracts of Met. Obs. of R.E. Graham's Town.
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    (9) '61. Letter from Sir Thos. Maclear to Adm. Fitzroy.
12. Charts showing surface temperature of S. Atlantic, pubd. by Met. Office.
13. Met. Charts of the Ocean District adjacent to C.G.H., with remarks thereon in separate volume. No. 43 of publications issued by Met. Off., '82. (Most valuable and interesting.)
14. Report of the Gales experienced in the Ocean District adjacent to C.G.H., by Capt. Toynbee, F.R.A.S., '82. No. 44 of publications issued by Met. Off. (Valuable.)

II. ii. REPORTS PUBLISHED BY THE CAPE GOVERNMENT.

In *Government Gazette* from Sept. 1818 to June 1825, various meteorological registers are from time to time included.

The majority are from Cape Town, and are signed P. E. Wahlstrand, and contain the max. and min. of temperature and pressure during each day, also two observations of wind and weather.

Observers were most active during the years 1821, 1822, 1823, and slips, apparently procured from the printers of the *Govt. Gazette*, have been bound together in 3 volumes, one for each year. These volumes are in the P.L. The following are the records as far as ascertained:—

1818. Cape Town. Sept., Oct., Nov., Dec.
1819. Cape Town. Jan.-Dec. [When a month is named it is meant that month is included.]

1820. Cape Town. Jan.-Dec.
1821. Cape Town. Jan.-July.
Zwartland. June–Dec.
Stellenbosch. Jan.–Dec.
Tulbagh. Jan.–Dec. [Feb. drought in Roggeveld. Farmers trekked to Zak R.]
Swellendam. March–Dec.
George. Nov., Dec. Drought.
Uitenhage. March–Dec.
Bathurst. March–Dec.
1822. Cape Town. May–Dec.
Zwartland. Jan.–Dec. Drought in March.
Stellenbosch. Jan.–Dec. Heavy rains in winter.
Tulbagh. Jan.–Oct. Drought in Feb.
Worcester. Nov., Dec.
Swellendam. Jan.–Dec. Drought Jan. Heavy rains winter.
George Town. Jan.–Dec. Jan. 1821–March 1822 continued drought.
Uitenhage. Jan.–Dec.
Albany. Oct., Nov.
1823. Cape Town. Jan.–Dec.
Zwartland. Feb.–Dec.
Stellenbosch. Jan.–Dec.
George. Sept. Great drought behind the mountains.
Swellendam. Jan.–Dec.
Uitenhage. Jan.–Oct. and Dec. Oct. very wet.
1824. Cape Town. Jan., Apl., May, Aug., November.
Stellenbosch. Jan., Apl., May, July.
Clanwilliam. Jan.
Swellendam. Apl., May.
1825. Cape Town. Jan., March, Apl., June.
Swellendam. Apl.
Stellenbosch. June.

1862. First Report of Met. Com. of C.G.H., 7 July.
1865. Minority Provisional Report, Dr. Adamson, for 1864.
Results deduced from Met. Obs. made at certain stations in Col. of C.G.H., in years '61, '62, '63, '64, '65.
Results deduced from Met. Obs. made at certain stations in Col. of C.G.H., in years '66, '67.
Results deduced from Met. Obs. made at certain stations in Col. of C.G.H., in years '67, '68.

1875.	Report of Met. Com. of C.G.H., '77.	[A. 26–'76.]
1876.	,, ,, ,,	[G. 67–'77.]
1877.	,, ,, ,, '78.	[G. 41–'78.]
1878.	,, ,, ,, '79.	[G. 64–'79.]
1879.	,, ,, ,, '80.	[G. 35–'80.]

(First year of inspection by Secretary.)

1880. Report of Met. Com. of C.G.H., '81. [G. 45–'81.]
1881. ,, ,, ,, '82. [G. 101–'82.]
1882. ,, ,, ,, '83. [G. 45–'83.]
1883. ,, ,, ,, '84. [G. 48–'84.]
Including means of rainfall for each month at seventy-three places.
1884. Report of Met. Com. of C.G.H., '85. [G. 27–'85.]
Including arrears of rainfall, means of temperature, and lithographic curves of rainfall.

Dr. Gill, F.R.S., on S.A. Met. [G. 5–'81.]

II. iii. REPORTS PUBD. BY NATAL GOVT.

Annual Reports, 1863, &c.
Obs. at Maritzburg, '64, '65.
,, Durban, '82. HH.
Reports of Com. on Forests, with rainfall tables. 1880.

II. iv. MISCELLANEOUS REPORTS.—A. OFFICIAL.

Novara Obs. P.L. In the Met. Tagebuch of the Austrian discovery ship *Novara* are some obs. taken at Simon's Town.

United States War Dept. Reports. Simultaneous observations over the whole globe.

II. iv. MISCELLANEOUS REPORTS.—B. NOT OFFICIAL.

Nieuwe Algemeene Beschrijving van de Kaap de G.H. Amsterdam and Harlingen, 1777.

Lacaille's obs. taken in 1751, 1752.

Prevailing winds S.E. and N.W; clouds; law of rotation; temperature; seasons; barometer.

An Account of Col. of C.G.H., for information of Emigrants, London, 1819.

Only general notice of climate.

State of C.G.H. in 1822. Murray, London, '23. P.L. No author mentioned, said to be Bird. Ed. by H. T. Colebrooke.

p. 370. Abstract of barometer and thermometer obs. kept from Sept, 1818-July 1821; monthly means and max. and min.; no note of time of day at which obs. were taken, or of exposure, or of temperature of mercury; apparently the same as those which appeared in *Govt. Gazette.*

131. Account of gale, July 18-24, from *Cape Town Gazette.*

180. Climate of Zuurveld; moisture often fails; want of periodical rains placed crops in hazard every year.

182. General want of rain: frequent drought in Nov. and Dec. spoils crops of grain.

242. Excessive rains and storms in July, 1822, about the Cape; drought in Albany.

376. Rains more regular and abundant (?) on the West side of S.A. than on the East.

Port Elizabeth Obs., pubd. by Lighthouse Keeper (not very accurate).

D. 1. Results deduced from Met. Obs. made at Lighthouse, Port Eliz., in years 1867-1872, by Chas. Hammond, Port Eliz., '73.
D. 2. Results deduced from Met. Obs. made at Lighthouse, Port Eliz., in years 1873-1877, by Chas. Hammond, Port Eliz., '78.
D. 3. Results deduced from Met. Obs. made at Lighthouse, Port. Eliz., in years 1878-1882, by John Knight, Port Eliz., '82.

Met. Obs. at *Maritzburg*, '64. Folio.
Met. Obs. at *Durban*, '75. Folio.

III. PUBLICATIONS OF SOCIETIES.

i. PROCEEDINGS OF THE BRITISH (NOW CALLED THE ROYAL) METEOROLOGICAL SOCIETY.

NO. OF VOL.	DATE.	PAGE.	AUTHOR.	SUBJECT.
3	1866	203	R. Mann, M.D.	Leading Features of the Climate of Natal.
	1867	340	,,	Atmospheric pressure in Natal.
4	1868	139	,,	Rainfall in Natal.
,,	,,	231	,,	Exceptionally heavy rainfall in Natal.
,,	1869	286	Sir T. Maclear.	Results of obs. at R. Observ., C. of G.H., from 1842 to 1861.
5	1870	84		Abstract from obs. in Colony of C.G.H., compiled by a Government Commission.
,,	,,	123	R. Mann, M.D.	Rainfall in Natal.
,,	,,	150	,,	Temperature of Air in Natal.

After this date the society published a Quarterly Journal, instead of Volumes of Proceedings.

QUARTERLY JOURNAL OF METEOROLOGICAL SOCIETY.

VOL.	DATE.	PAGE.	AUTHOR.	SUBJECT.
i.	'72-'73	95	R. J. Mann, M.D.	Note concerning Natal rainfall.
,,	,,	97	Boulton, Lieut., R.N.	Note on climate of S.W. coast of Africa.
,,	,,	266		Heavy rainfall at Natal, 4 March, '73.
ii.	'74-'75	235	La Touche, Rev. J.D.	Hailstorm at Natal.
iv.	'78	25	Bourke, Com. E. G., R.N.	W. Coast. from C. Verde to C. of G.H.
	,,	173	R. J. Mann, M.D.	Contributions to the Meteorology of Natal.
v.	'79	95	K. I. Marks, F.M.S.	Obs. at Calvinia.
vii.	'81	3	John G. Gamble.	Rainfall in S. Africa.
		127	Meteorological Office.	Progress of discuss. of Ocean Meteorology off C. of G.H.
		249	John G. Gamble.	Note on a comparison of max. and min. temperature and rainfall observed on Table Mt. and at the Royal Observatory, Cape Town, during January and February, '81.
viii.	'82	238	D. Gill, LL.D., F.R.A.S., F.R.S.	On the effect of different kinds of thermometer screens and of different exposures in estimating the diurnal range of temperature at the R. Obs., C.G.H.
ix.	'83	116	Capt. Hepworth.	Weather Forecasts and Storm Warnings on the coast of S. Africa.
		130	Met. Office.	Meteorology of the Ocean District adjacent to the C.G.H.
x.	'84	295	R. Mann, M.D.	In discuss., Hot Winds of S.A.

III. ii. ZEITSCHRIFT DER ÖSTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE.

VOL.	PAGE.	
ii.	116	Increasing dryness of South Africa.
iii.	439	Rainfall, Natal.
iv.	18	Fritsch, Increasing dryness of South Africa.
	31	Cornelissen. On the temperature of the sea near the Cape.
v.	122	Rainfall at Port Elizabeth Lighthouse, '67, '68.
	374	Mann. Climate of Natal. Brit. Ass., 1868.
	428	Climate of Cape Town, Royal Observatory.
vii.	204	Buchan & Hann. Tables of mean temperature and rainfall in S.A.
	213	Mühry. Wind—Ascension at Table Mt.
ix.	255	Cornelissen. Mean height of barometer in storms round S. extremity of A.
xiii.	38	Periodicity of rainfall in S.A. (N.B. Livingstone's view of a periodicity of 11-12 years.)
	417	Baron v. Danckelmann. Climate of Hereroland.
xiv.	208	Dr. Mann. Climate of Natal.
xv.	498	New Meteorological Stations, Hereroland.
xvi.	511	Gamble. Rainfall in S. Africa.
xvii.	19	Climate of Pretoria, Transvaal. Jeppe's Directory. Observations of J. R. Lys.

III. iii. PUBLICATIONS OF THE ROYAL METEOROLOGICAL INSTITUTE OF THE NETHERLANDS, UTRECHT.

Uitkomsten van Wetenschap en Ervaring aangaande Winden en Zeestroomingen in sommige gedeelten van den Ocean. (A serial publication, the following refer to our district) :—

1857. The Agulhas current, as deduced from the temperature of the sea.
1858. Storm and Rain Charts for vicinity of Cape of Good Hope.
1859. Wind Charts of Indian Ocean to lat. 50° S. and Eastwards from 15° E., in 5° squares for each month.
Sea temperature means from lat. 30° to 50° S , and longitude 0° to 45° E.; in single degree squares, for the months of April and June.
The mean Barometric Pressure in the Indian Ocean.
1861. Monthly Charts of Sea Temperature in the S. Atlantic and Indian Oceans.
The influence which the Agulhas current exerts on the Atmosphere.
1868. J. E. Cornelissen on the temperature of the sea at the surface near the South point of Africa.
1874. On the mean height of Barometer and Storms round the South point of Africa. (Gemiddelde Barometerstand en Stormen rond Afrikas Zuidpunt.)

III. iv. SOUTH AFRICAN PHILOSOPHICAL SOCIETY.

TRANSACTIONS.

VOL.	PAGE.	
i.	45	F. Guthrie. Heat of the Sun in S.A.
,,	13 (should have been 73.)	John G. Gamble. Rainfall of S. Africa.
,,	219	John G. Gamble. A storage reservoir
ii.		in the Achterveld. Notes on Evaporation.
iii.	91	John G. Gamble. On some of the problems awaiting research in S.A.
	104	John G. Gamble. On the summer and winter temperature in S.A.
	xix	John G. Gamble. The Barometer and the winds, presidential address.
	5	John G. Gamble. Proposals of Table Mt. Water Supply Co.
	15	W. B. Tripp. The R. Buffalo, its watershed and flow, in connection with the rainfall.
	30	J. E. Balfour. On some South African rivers.

III. v. ROYAL GEOGRAPHICAL SOCIETY'S JOURNAL.

YEAR.	VOL.	PAGE.	
1834	4	363	Instructions to Dr. Andrew Smith for his voyage into the interior. June, '34.
		371	Report of Dr. Andrew Smith from Caledon R. Sept., '34. The drought had prevented his getting to Latakoo (Kuruman).
'35	5	367 sqq	*Instructions* for making and registering Met. Obs. at various stations in S.A. and other countries in the S. Seas, drawn up by Met. Comm. of S.A. Lit. and Phil. Inst. (cf. also S.A.Q.J., p. 27.)
'36	6	403	Report of Dr. Andrew Smith. "The *climate of Bechuanaland* must have undergone great changes; within the memory of persons yet living sea-cows inhabited the Kuruman River where it is now without a drop of water."
			Volume 13 and volumes 15 to 23, both inclusive, are wanting in P.L.
'55	25	102	Andersson's Explorations in S.A. *Climate of Great Namaqualand.* Little or no rain falls about the lower course of the Orange River. The Namaquas are loud in their complaints that less rain falls now in their country than a quarter of a century back; this seems also to be the case in Damaraland.
'55	25	256	*Sutherland* (P. C.). Met. Obs. made during passage from London to Algoa Bay. Currents off S. coast.
	26	95	*Moffat.* Visit to Moselekatze, K. of Matabele. Writing on 27 July, '54, from watershed between Limpopo and Zambesi, 20° S. "The wind cold and disagreeable, the trade wind as usual, with thick misty clouds and sand sweeping over our heads. When the natives were asked if it would not rain, they laughed and said, 'Who ever saw rain during the winter months?' They appear no more to expect this than that the wind should blow from the W. any part of the year."
		158	*Hopkins.* Causes of dryness in certain countries.

Royal Geographical Society's Journal.

YEAR.	VOL.	PAGE.	
	27	356	*Livingstone* on the drying up of S.A.
	35	106	*Wilson* (James Fox). Water supply of O.R. basin; rough rainfall map incorrect for W. coast—drying up of fountains—advocates artesian wells—cause, burning the plains and destroying the timber. Wood wasted in traps for wild animals—dwellings—trees burnt because wood so hard. Case of Griquatown, accidental destruction of many wild olive trees on plains around and shrubs on neighbouring heights known to have preceded diminution of water supply.
	35	147	*Toynbee.* Spec. Grav. Temp. and Currents betw. England and India, with map. Cold water, Agulhas Bk. In Table Bay 51° in Feb. Natal has current 78° running by all the year round. If it were not for Mozambique warm current icebergs would be troublesome off the Cape. The sea on the Agulhas Bank is always several degrees colder than that to the Eastward.
	37	48	*Mann* (R. J.). Phys. G. and climate of Natal.
	39	233	*Erskine* (St. V.). Journey from Leydenburg to mouth of Limpopo and back, through Swaziland and Zululand—frequent
		245	drought in N.E. Transvaal. Prevailing winds in winter, S.E. or N.W., former damp and cold.
	41	100	*Baines.* Gold Fields between Limpopo and
		105	Zambesi. Greatest cold at night 24½° F.
'72	42		*Elton* (F.). Explor. of Limpopo. In Makalaka country, E. of Matabele, waterpools are few and far between. All those situated away from the rivers drying up in the hot season.
	45	45 sqq	*Erskine* (St. V.). Journey to Gasa
		87	country, between Limpopo and Sabi. Coast district almost rainless. Sky covered with clouds, which float on inland.
'78	48	25	*Erskine* (St. V.). Third and Fourht journeys in Gasa country.

Royal Geographical Society's Journal.

YEAR.	VOL.	PAGE.	
		34	*Erskine* (St. V.). Temperature Tonga country.
		283	*Warren* (C). Gold Fields and Delagoa Bay.
		286	Climate of Delagoa Bay.
		287	*Bailie* (A. C.) Barkly to Taungs, Shoshong, &c.
		290	*Bailie* (A. C.). Very dry season of '76.

PROCEEDINGS R.G.S.

VOL.	YEAR.	PAGE.	
v.	'60-'61	16	**Chapman,** *Jas., Jun.* Letter to Sir G. Grey—writing in January, '60, from Otjimbinque he says:—"We have had an unusually dry season, in the whole country up to the lake the fountains have failed, and if the desiccation continues a few years longer at the rate it has done during the last four years, I fear we shall only be able to reach Ngami in the rainy season." "Lake Ngami has been very full for the last couple of years, and the Botletlie R. has filled up the great salt lake (which I discovered in '54) with fresh water from Ngami."
ix.	'64-'65	106	**Wilson,** *J. Fox. Desiccation of Orange R. basin.* cf. Q.J. Reckless felling of timber and burning pasture. In discussion *Livingstone* attributed it to the *elevation* of the country, more especially on the West side of the continent. *Galton* explained why more timber is cut down now than formerly, [i.] Kaffirs are more wasteful than Hottentots. [ii.] Iron has been introduced and axes are more plentiful. Lord Stratford de Redcliffe said water supply of Constantinople comes from streams in the forest of Belgrade. Some years ago permission given to cut down trees, speculators cut largely, reservoirs began to fail and the permission had to be revoked.

Proceedings Royal Geographical Society.

VOL.	YEAR.	PAGE.	
x.		338	**Toynbee.** Sea between England and India. Sea currents off S.A. Dryness of Namaqualand, wind has to pass over so cold a sea that its capacity for moisture is greatly increased when it comes into contact with these heated lands. Cold heavy water met with near Danger Point.
xi.		18	**Mann.** Phys. G, and Clim. of Natal. cf. Q.J. Met. S. In discussion Toynbee says Mozambique current 78° off Natal. Mann in reply says sea breeze always refreshing and cool, also the Mozambique current does not come in close to the land in Natal parallels.
xiii.		360	**Buchan,** *A.* On determination of heights by the observation of atmospheric pressure.
xiv.		377	**Hodding.** Spec. Grav. of water in S. Atlantic. The meeting of the Mozambique and Antarctic currents often very abrupt—condensation of vapour—latent heat set free—hence storms off the Cape. Spec. Grav. of Antarctic lower than that of Mozambique.
			After vol. xx. not in P.L.

NEW SERIES IN MONTHLY VOLUMES.

VOL.	YEAR.	PAGE.	
	79	?	**Blencowe.** Phys. Geog. of Zululand and borders.
	80	506	Climate of Matabele country. (Missions Catholiques.) Mean temperature in summer 77°—in winter 68°. No rain in winter—from November-March rain extremely heavy. Frequent storms.
iii.	81	1-20	**Frere,** *Sir B.* Temperate S.A.

Proceedings Royal Geographical Society.

VOL.	YEAR.	PAGE.	
iii.	81	174	**Selous.** Chobe and Okavango Rivers rise in the dry season.* Why is this? No reply given.
			In former years the Botletle used to rise so high that its waters ran into the large salt-pan N'twe-twe. Of late years it has never reached the saltpan, and in '79 it failed for the first time to reach the gardens of the Makalakas.
iii.	81	208	**Bradshaw,** *Dr. Benj.* Chobe R. Rains
		212	commence in Oct. or Nov., and generally end in March or April. The rest of the winter is fine, with perhaps one shower in June or July, very often none. Prev. winds E., except during rains, which often come from W. Hailstorms rare. Temperature in shade Oct. and Nov. 95°-110°.
iv.	82	97	**Duparquet.** Missions Catholiques. R.G.S.J. Ovampoland. Entire absence of rain on coast S. of Cunene R.
v.	83	273	**Phipson-Wybrants.** Sabi River delta. Heavy dews in November drench traveller like rain.
		470	**Galton,** *F.* Climate of coast about Walvisch Bay. Discussion on Lord Mayo's paper on his journey to Humpata and the Cunene.
vi.	84	19	**Anderson,** *A. A.* Geog. of S. Cent. A.
		22	December-May rainy season on 'Oup. R., Kalihari.
		24	Rain seldom falls about Back R., between Hygap and G. Fish.
		29	Direction of stream between Ngami and Makarakara.
			In April and May Easterly, in June and July Westerly, acc. to rainfall; same with stream between Ngami and Chobe.
		31	South of Kolobeng (Goshen) winters mild.
		32	North of Shoshong, Dorst (Thirst) land, no rain falls from April-November.
		285	**Selous.** Watershed between Sabi and Zambesi. "Cold wind blows almost uninterruptedly from S.E.
			Droughts and famines unknown.

*This does not agree with Bradshaw.

III. vi. PROC. R. COL. INST.

	ii.	93	**Mann,** *Dr.* Phys. and Econ. Asp. of Natal.
'76-'77	viii.	186-7	**Symons,** *C. J.* Clim. of various Brit. Col.
	x.	108, 110	**Noble,** *J.* Brit. S.A.

III. vii. MISCELLANEOUS SOCIETIES.

Royal Society.	Proc. xix.	p. 389.	**Stone.** Temperature and sunspots.
,,	?		Normal circulation and weight of atmosphere in North and S. Atlantic.

RHEINISCHE MISSIONS GESELLSCHAFT,
Berichte der.

1850. No. 10.
1851. 24, 25.
And probably others.

LES MISSIONS CATHOLIQUES.

Notices of Umzila's country between Limpopo and Zambesi.
Ovampoland.

IV. i. PERIODICALS.

NATURE. London, Macmillan.

iv.	305	Vintcent Erskine.	Meteorology at Natal.
vii.	98	?	Meteorology of the future. Sunspots and rainfall at the Cape.
	443	E. J. Stone, F.R.S.	Letter on the connection of sunspot period with Meteorological phenomena.
x.	115	E. J. Dunn, in *Cape Argus.*	Hailstorm in Natal.
xviii.	295	R. J. Mann, M.D.	Meteorological Soc. Jour., June, '78. Maritzburg Observations, 1860-1865.
xix.	131	?	Sudden change of temperature in the Transvaal.
xxiv.	166	?	Thunderstorm at the Cape.
xxv.	140	Met. Office.	Met. Charts of Sea off C.G.H. Intermingling of hot and cold currents produce atmostph. disturbance.
xxvi.	206, 207	Prof. Loomis.	Rainfall of the Globe.

IV. ii. SYMONS' MONTHLY METEOROLOGICAL MAGAZINE.

Vol. iv.	1869	p. 35	Port Elizabeth. Cape of Good Hope rainfall.
vii.	1872	75	Results of Obs. at R. Obs., C.G.H.
		87	Review of Bates' Handbook of S. Africa.
		161	Mr. Blore's Experiments on Evaporation at Wynberg. (Two jars, one exposed, the other sheltered, during five days the former lost an inch more than the latter: inference in favour of forest planting.)

[The compiler has had no opportunity of examining recent numbers of this periodical.]

Vol. xx.	1885	19	Rainfall of Cape Colony. Notice of lithographic diagrams prepared by J. G. Gamble.

IV. iii. PETERMANN MITTHEILUNGEN. P.L.

VOL.	YEAR.	PAGE.	NAME.	SUBJECT.
i.	1855	273	**Berghaus.**	Natal and S.Af. Free States. Notices of climate.
ii.	'56	527	Natal Agr. and Hort. Soc., 7th Annual Report.	Rainfall, Durban, Natal.
iv.	'58	42	**Maclear,** *Sir Thos.*	Results of Observations, 1842-1856.
		196-202	**Böhm,** *Dr.*	Süd Afrika in 1858. Section on Klimatologie. Good.
v.	'59	443	**Hall.**	Manual of S. African Geography. Some tables.
vii.	'61	325	**Chapman,** *James.*	Notes of S. Africa. Climate.
		326	**Merensky.** Berliner Missions Bericht.	
		366	**Andersson.**	Okavango River.
xiii.	'67	20	**Forssman.**	Climate of Transvaal. Magaliesberg the line of division.
		209		Climate in Natal.
		156	**Wilson,** *J. F.*	Water supply in basin of Orange River. J.R.G.S. xxxv. '65, pp. 106-109. Dryness increased by cutting down trees.
xiv.	'68	389	**Fritsch,** *Dr. G.*	Klima. von Süd Afrikâ. Z. d. G. f. Erdk. Berlin. iii. pp. 132-162.
		390	**Mann,** *Dr.*	Climate of Natal. J.R.G. Soc. xxxvii. 48-67.
xv.	'69	156	**Hahn,** *J.*	Ovahereró. Z. d. G. f. Erdk. Berl. iii. 193-224. And vol. iv. 493-507.
xvi.	'70	1, 92, 139	**Mauch.**	?
xvii.	'71	254	**Mauch.**	Journey down the Vaal from Potchefstrom. W.N.W. and S.W. winds prevail in summer.

PETERMANN MITTHEILUNGEN—*continued.*

VOL.	YEAR.	PAGE.	NAME.	SUBJECT.
xix.	'73	96	**Hahn,** *Hugo.*	Damaraland drying up; gets rain from the East.
xxii.	'76	115	**Cohen.**	Review of his Journey from Leydenburg to the Gold Fields.
xxiv.	'78	306-311	**Böhm & Bernsmann.**	Meteorology of Hereroland. Climate has become drier, Wind at Walvisch Bay from September to January S.W.; inland N.W. January-May changeable. May to August East, unbearably hot, with dust.
xxvi.	'80	249-250	**Fritz,** *Dr.*	Die Veränderlichkeit der Wassermengen der gewasser des Festlandes.
	'82		**Wichmann,** account of St. Vincent Erskine's Travels in Gazaland.	Coast region dry. Umzila's chief place and neighbourhood hilly country, well watered.
	'84	233	**V. Danckelmann.**	Met. Beob. in Damaralande.

PETERMANN MITTHEILUNGEN.

ERGÄNZUNGSHEFTEN (= SUPPLEMENTS) NOT IN P.L.

NO.			
24		**Jeppe.**	Die Transvaalsche Republik.
37		**Mauch.**	Reisen im Inneren von Süd Afrika.
38	1874	**Wojeikof.**	Die Atmospharische Circulation. (p. 28.)
48	1876	**Czerny.**	Die wirkungen der Winde auf die gestaltung der Erde. (Reference to Karroo and Kalihari.)

IV. iv. AUSLAND. German Periodical. P.L.

YEAR.	PAGE.	
1864.	591.	Climate of Transvaal, from *Natal Mercury*.
1870.	1076. 1092.	**Fritsch.** Desiccation; rains local.
'71.	433.	**Haverland.** Desiccation. Destruction of forests.
'75.	445.	**Mohr.** Climate of Transvaal.
'77.	839.	**Shaw,** *Dr. John.* Sheep eating grass change climate.
	891.	Klima-Aenderungen an der Aequatorial grenze der subtropischen Regenzone. Desiccation of S.A.
'78.	788.	Climate of Damaraland. cf. Petermann.
'80.	349.	Met. Verhältnisse in W. Afrika. In S.W. Winter fog. Summer rain. Thunder clouds come from E, driven back by W. wind, hence the rain occurs inland.
'81.	441.	**Alsberg,** *Dr. M.* Regenfall, Vegetation und Bodenkultur in S.A. High mts. intercept moisture. No dry years on the high lands of the Transvaal. Certainly a drying up. It is caused by felling of trees and destruction of vegetation by fire—of old date. Vasco de Gama noticed bush fires. Remedy, tree planting on a large scale. Small chance for artesian borings. Provision of water must be increased by reservoirs.
'83.	489.	Climate of Damaraland—no rain on coast—season when rain may fall, end December to beginning of May.
	714.	**Büttner.** Climate of Angra Pequena. Influence of cold ocean current.
	883.	**Büttner.** Climate of S.W. Africa. More rain further you go from the coast. Rainy season begins and stops earlier in the interior.

IV. v. SOUTH AFRICAN QUARTERLY JOURNAL.

EDITED AT THE SOUTH AFRICAN INSTITUTION—
PRINTED AT CAPE TOWN.

Vol. i. Contains 4 numbers for year October, 1829–September, 1830. Paged consecutively 1–464, with Index.

Vol. ii. Contains number 5, dated October, 1831. pp. 9–140.
Also Annual Report of S.A. Lit. and Sc. Inst. for 1833. pp. 1–26.
Also S.A.Q.J. 2nd series.
No. 1. Part 1–2 and 3. October–December. '33.
No. 2. Parts 1–2 and 3. January–March. '34.
No. 3. Parts 1, 2 and 3. April–June, '34.
No. 4. Parts 1, 2 and 3. July–Sept., '34.

The 2nd series is paged consecutively 1–388, following it is an Index to 2nd series, and a table of contents to No. 5, 1st series.

Vol. i. p. 18. **Buchenroder.** Earthquakes at the Cape in in Dec., 1809, with Met. Diary from 4th–27th.

101. Met. register for Cape Town, 1829, means and extremes for each month of thermometer and barometer—most frequent winds—number of rainy, cloudy and clear days.

141–143. Climate of Delagoa Bay. Rain always comes off the land with S.W. winds. After the gale the wind goes round to S.E.—weather becomes fine—wind afterwards draws to N.E.

306. **Jomard.** Geog. S. of Paris. Discoveries in Africa. Zak and other rivers lost in the sands of the desert.

403. **Chase.** Travels of two traders in Bechuanaland. Upper Hart R. only a series of pools in July.

417. **Bain,** *A. G.* Barolong country. Pool in bed of Malopo R. in August could not last many days longer: springs few and far between.

Vol. ii. No. 5. p. 105. **Adamson,** *Dr.* Self registering thermometer.

Vol. ii. p. 117. Annual Report of S.A. Institution, 1834. Little done in Meteorology. Some registers from Port Elizabeth—early ones unsatisfactory. Best is an abstract of obs. on temperature pressure and wind in 1830 by Mr. Francis.

Need of synchronous charts.

Report of S.A. Inst., '33. Met. Inst. recd. and committed to Dr. Adamson.

Second Series. Paging begins again.

136. **Chase.** Progress of Geog. Disc. in S.A.

Dr. Campbell had abundant rains in winter, 1820, in Bechuanaland!

207. **Morgan,** *Dr.* Register of temperature, wind, weather at F. Wiltshire, 1832.

295. Caffer's Drift, abstract of obs. of temperature, Jan. '32–May '34.

296. Importance of different points of observation.

301, 302. Abbreviations for wind and weather.

321. Instructions for M. Obs. in S.A., by the M. Committee of the S.A. Lit. and Philos. Inst., forming part of First Report to the Institution.

382. Second Report of M. Committee.

Barometer fluctuations not same at R.O. and Feldhausen.

Variation of Barom. height with latitude.

Tide at Simon's Bay.

Annual and diurnal fluctuations of Barometer.

vi. EASTERN PROVINCE MONTHLY MAGAZINE.

GREY L.

1857. Vol. i. 264, 432. Hall, H. Physical Features of S.A.
ii. 59 ,, ,, ,, ,,
122, 246, 309, 371, 433, 498, 562, 624, 688, Met. Obs. at Graham's Town. Sept., 1857–May, 1858.

IV. vii. CAPE MONTHLY MAGAZINE.

FIRST SERIES. P.L.

DATE.	VOL.	PAGE.	AUTHOR.	SUBJECT.
'57 Jan.–June.	I.	47	Maclear, T., F.R.S.	Astronomical and Meteorological Sketches.
		64, 133, 261, 390	Royal Observatory Staff.	Met. Obs. Nov., '56, Dec. '56, Jan., Feb., March, Apl., '57.
July–Dec.	II.	64, 128, 192, 256, 352, 432	,,	Met. Obs. May, June, July, Aug., Sept., Oct., '57.
'58 Jan.–June.	III.	64, 128, 255, 383	,,	Met. Obs. Nov., Dec., '57. Jan., Feb., March, Apl., '58.
		192	Maclear, T. F.R.S.	Meteorology. Mean temperature, &c.
		248	,,	Fall of rain in the vicinity of Table Mt.
		319	,,	Description of square gauge used by Penketh, at Town Hall, and comparison with R. Obs.

CAPE MONTHLY MAGAZINE—*continued.*

DATE.	VOL.	PAGE.	AUTHOR.	SUBJECT.
'58 July–Dec.	IV.	174, 177	Blore, W. L.	The weather and its effects. Rainfall and wind on the two sides of Table Mt. Barometric scale for Commercial Exchange.
		238	Maclear, T. F.R.S.	Tension and Dewpoint.
		64, 191, 256, 320, 384	Royal Observatory Staff.	Met. Obs. May, June, July, Aug., Sept., Oct., '58.
'59 Jan.–June.	V.	112	Maclear, T., F.R.S.	How to observe temperature.
		279	,,	Tables for Dewpoint, Tension and Humidity.
		64, 128, 192, 256, 384	Royal Observatory Staff.	Met. Obs. Nov., Dec , '58. Jan., Feb., March, '59.
July–Dec.	VI.	64, 127, 128, 256, 319, 320, 384	,,	Met. Obs. Apl., May, June, July, Aug., Sept., Oct., '59.
		254	Blore, W. L.	Notes on pluviometry.
'60 Jan.–June.	VII.	64, 128, 192, 256, 320	Royal Observatory.	Met. Obs. Nov., Dec., '59. Jan., Feb., March, '60.
July–Dec.	VIII.	257	Layard, E. L.	Met. Committee,
		63, 64, 128, 192, 256, 320	R. Obs. Staff.	Met. Obs. Apl., May, June, July, Aug., Sept., '60.
'61 Jan.–June.	IX.	64	,,	Met. Obs. Oct., '60.
July–Dec.	X.	192, 256, 336, 400	,,	Met. Obs. July, Aug., '61. Nov., Dec., '60.
'62 Jan.–June.	XI.	64, 256, 320, 390, 391	,,	April, '61. Nov., '61. June, '61. May, Sept., '61.

SECOND SERIES. (Only a few numbers in the P.L.)

DATE.	VOL.	PAGE.	AUTHOR.	SUBJECT.
'71	ii.	79	Haussmann.	Souvenirs du Cap. Met. Diary, 1859.
'71	iii.	129	Maclear, Sir T., F.R.S.	Sir J. Herschel at the Cape. Some Met. Notes.
'73	vii.	31	G. A(lston).	Met. data.
	—	383	Not signed.	Met. Obs., with note by editor.
'74	viii	189, 234	Bolus, H. Translation of Meyer's Drège.	Climate S.A., from botanical point of view.
'76	xii.	275	Lacaille.	Met. Records of visit to the Cape. Pubd. in Mem. Acad. of Sc., Paris, 1755.
		316	Ross, Dr.	S.A. as a health resort.
1876	xiii.	124 } 359 }	Gamble, John G.	Barometric observations of heights, and the use of the Aneroid.
		127	Secretary Met. Com.	Meteorology and Tables.
		255	,,	Met. Observations.
1877	xiv.	64	Secy. Met. Comm.	Meteorology.
		126	Jackson, Sidney	Rainfall in the Victoria West Karroo.
		127	Secy. Met. Com.	Observations.
		387	,,	,,
	xv.	320	,,	,,
		383	,,	,,
1878	xvii.		Freeman.	Rainfall at Longwood, Wynberg.

CAPE MONTHLY MAGAZINE.—THIRD SERIES.

1879	i.	104	Σ. Lovedale.	Meteorology of S.E. Africa. N.B. Clouds to seaward—sign of rain. Weekly periodicity.
1880	ii.	128	Met. Comm.	Meteorol. Observations

CAPE QUARTERLY.

1882	i.	544	Alston, G.	"Heavy Wet."
	ii.	135, 312		
1883	ii.	482	Beswick.	Climate of S. Africa.

IV. viii. CAPE FARMERS' MAGAZINE.

GRAHAM'S TOWN. P.L.

Oct., '64 and Feb., '65, paged together.

p. 63, 127, 191, 367. Weekly averages of Graaff-Reinet Met Register for Sept., Oct., Nov., Dec., 1864, Jan., 1865.

p. 64, 128, 192, 368. Met. Register for R. Obs. for Aug., Sept., Oct., Dec., 1864. Barometer; dry, wet, max., min., thermometers; wind, rain, and cloud.

Ditto. May, 1865. Paging begins again.

p. 184. Weekly averages of Graaff-Reinet Met. Register for Feb., March, April, 1865.

IV. ix. MISCELLANEOUS PERIODICALS, &c.

SOUTH AFRICAN ADVERTISER.

66, 72, 75, 239, 240. Travels of A. G. Bain.

CAPE ALMANAC AND DIRECTORY.—S. Solomon & Co. Cape Town.

1879. pp. 73, 74. Climate of Cape Col.
'80. p. 14. Ditto.
'81. pp. 56, 57. Ditto.
'82. p. 38. Ditto.
'83. pp. 32, 33. Ditto.
'84. p. 33–37. Reprint from R. Met. S.J. of Capt. Hepworth's Paper on Weather Forecasts and Storm Warnings on the coast of S.A.
'85. p. 33-37. Ditto.

NATAL JOURNAL.—GREY L.

1857. p. 103. Climate of Ekukanyeni, 5 miles from Maritzburg.
1858. p. 11. Thunderstorms and Protection against Lightning.
47. Abstract of Met. Register at Ekukanyeni.
52. The upland summer of Natal. Ekukanyani Obs. 2,055 ft. above sea level.

NATAL COLONIST. (Newspaper.)

Annual retrospects containing Met. Obs. taken at Natal Botanic Gard. 1875 to 1879.

Extra to "Natal Colonist," with rainfall at various places, down to 1879, incl.

NATAL ALMANAC DIRECTORY AND YEARLY REGISTER.

1871. St. V. Erskine on the Met. Obs. at Maritzburg and Durban.

NATAL MERCURY.

1864. ? Climate of Transvaal.

TRANSVAAL.

Jeppe's Directory from '79, Pretoria, has some notes.

COLONIAL MAGAZINE. London. FISHER, SON & Co. P.L.

1843. Vol. ii. p. 86. Saxe Bannister says the Kalihari is a parched and almost uninhabited waste with vestiges of ancient forests. The opinion justified that the drought in many parts of S.A. is attributable to the improvident destruction of trees by natives.

p. 88. Tambooki country "is too cold for natives."

244. Protracted drought in East. Prov. in 1842. Many farmers obliged to quit their farms by the entire failure of water. Both the Fish and Sunday's Rivers ceased to flow.

Vol. iii. p. 362. Abundance of rain in Kafirland in March and April, '43.

iv. 499. Storm in Algoa Bay. 29 Aug, 1843.

DETERMINATION AND DESCRIPTION OF CAPE IRIDEÆ,

CHIEFLY COLLECTED BY MR. ROBERT TEMPLEMAN, AND CONTAINED IN THE HERBARIUM OF PROF. MAC OWAN, F.L.S., DIRECTOR OF THE BOTANIC GARDENS.

BY DR. F. W. KLATT.

I. Acad. cæs. Carol.-Leopold. Naturæ Curiosor.

1.—GLADIOLUS ALATUS, Linn.

In arenosis Planitiei Capensis prope urbem, Sept. 1883, *Hb. M.O. No.* 2268.

2.—GLADIOLUS TEMPLEMANII (sp. nov.) Klatt.

G. cormo globoso, tunicis fibrosis; caule flexuoso simplici crasso tereti glabro; foliis circiter 3-4 *basi breviter vaginantibus anguste ensiformibus acuminatis rigide coriaceis venosis, venæ promineæ primariæ* 6, *secundariæ* 6 *bifarie pilosæ; floribus* 4-6 *alternantibus spicatis; spathis inæquivalvibus, valvis margine albo-membranaceis parallelo-venosis interdum ramoso-venosis, valva exteriore basi amplexicauli elongata ovato lanceolata herbacea, interiore apice bifida; floribus magnis splendide luteis, tubo cylindrico erecto, limbi segmentis* 2 *superioribus exterioribus rhomboideis acutis, interiore superiore*

spathulato arcuato plicato basi purpureo maculato, 3 inferioribus ovatis acutis, laciniis omnino violaceo-venosis, genitalibus lacinias superantibus, antheris filamentis duplo brevioribus, stigmatibus obovatis fimbriatis. Hab. In monte Zwarteberg (Caledon) pone thermas, Sept. 1884, *legit Templeman—Hb. M.O. No.* 2608.

Stems 6-8 in. high, simple, terete, glabrous, bent backwards and forwards. Produced leaves 2 or only 1, linear ensiform, 2 lin. broad, narrowed to the point, rigid in texture, prominently nerved and on the bilateral nerves beset with stiff hairs. Flowers 4 or 6 arranged in a strict spike; yellow with scarlet feathering nerves. Perigone tube funnel-shaped, narrow, erect, 5 lin. long; upper outer segments rhomboidal, 9 lin. long, 7 lin. broad, upper inner segment spathulate incurved, 15 lin. long, 5 lin. broad, the three lower segments smaller, ovate. Stamens longer than the perigone segments except the upper one; anthers linear 4 lines long curved at the top. Style branches falcate, obovate fimbriate.

This fine species is a near ally of *Gladiolus alatus, Linn*, with leaves similarly rigid in texture and pubescent. The flowers have also some resemblance to *G. bicolor Bkr.* The following species of Gladiolus are distinguished by being more or less covered with hair. G. alatus, G. persicus, G. brevicollis, G. Orobanche, G. villosus, G. pubescens, G. hirsutus, and G. sericeo-villosus.

3.—Gladiolus maculatus, Sweet, Hort. Brit.

4.—Gladiolus grandis, Thbg.

In monte Zwarteberg (Caledon) pone thermas, Sept. 1884, *legit Templeman—Hb. M.O. No.* 2607.

5.—Gladiolus debilis, Ker.

In monte Zwarteberg (Caledon), pone thermas, Oct. 1884, *legit Templeman—Hb. M.O. No.* 2610.

6.—Gladiolus inflatus, Thbg.

Ad latera montis Zwarteberg, pone thermas, Oct. 1844, *legit Templeman, —Hb. M.O. No.* 2617.

7. Gladiolus biflorus (sp. nov.) Klatt.

G. cormo ovoideo, tunicis dilutè fuscis basi funiformi-laceratis, caule simplici gracili tereti, foliis superpositis alternantibus basi et apice rudimentariis vaginæformibus truncatis, folia media elongata angustè lineari crassa

unicostata basi longè vaginante; floribus 2 (*rarò* 3) *lilacinis spicatis, spathæ valvis magnis obovatis herbaceis margine purpureis, perigonii tubo brevi flavo apice ampliato figuris* 5 *cuneiformibus violaceis notato, laciniis subæqualibus obovatis apice mucronatis, genitalibus perigonio* 2-*plo brevioribus, stigmatibus curvatis elongatis latè ovatis margine fimbriatis.—Hab. In arenosis, hyeme inundatis, in planitie Capensi. Sept.* 1881, *Hb. M.O. No.* 2279.

Corm heart-shaped, 5 lines in diameter, outer coats light brown, split at the base into many strips. Stems 7-9 inches high, simple terete, bent. Flowers almost always 2, purplish-pink, violaceous in drying. Spathe-valves herbaceous, obovate, scarlet at the margins. Perigonium tube short, yellowish, with 5 cuneiform violet spots above. Segments nearly equal, obovate, mucronate at the tips, 8 lin. long, 3 lines broad. Stamens very short, anthers 3 lines long. Style branches as long as the stamens falcate, fimbriate. Leaves 5, the two basal ones being only sheaths, the two uppermost with a very short acute blade, the other one perfectly formed, elongated, often higher than the stem, very small, linear, rigid, prominently one-nerved, 6-8 inches long ¾ line broad, sheath 3 in. long.

Allied to *G. Orobanche, Red.*

8. Gladiolus gracilis. Jacq. *Ad latera montis Tabularis pone Van Kamp's Bay.* Sept. 1882, *Hb. M.O.* 2275.

9. Gladiolus recurvus. Linn. *In clivis ad latera montis Tabularis, occidentem versus. Sept.* 1884, *Hb. M.O. No.* 2558.

10. Gladiolus ornatus (sp. nov.) Klatt.

G. cormo globoso, tunicis fibrosis fuscis apice laceris, caule simplici flexuoso tereti; foliis, 5, 2 *inferioribus vaginæformibus, tertio elongato rigido angustè lineari acuto marginato unicostato caulem valde superante, basi longè vaginante, foliis superioribus abbreviatis; floribus* 3 *magnis laxè spicatis* (*ex sicco*) *violaceis; spathæ valvis herbaceis inæqualibus, valva exteriore elongata ovato-lanceolata acuta multistriata amplexicauli; valva interiore perigonium breve infundibulari-cylindricum includente; segmentis perigonii* 2 *superioribus exterioribus late oblongis obtusis margine undulato-crispis, interiore superiore plicato prominente, inferioribus maculâ flavâ obscurè violaceâ rhomboideâ emarginatâ pictis, exterioribus oblongo-lanceolatis, interiori oblongo prominentibus, genitalibus brevioribus; stigmatibus latis fimbriatis.—Hab. In arenosis planitiei Capensis prope Rondebosch. Oct.* 1884, *legit MacOwan. No.* 2553.

Corm globose, 4 lines in diameter, outer tunics of brown fibres slit at the top. Stem slightly flexuose, 1½ ft. in height, round, leafy. Leaves 5 in number, the 2 basal ones sheathlike, the third linear, strongly nerved

in the middle and on both sides, rigid in texture, long-sheathed, and much longer than the stem, the two uppermost with reduced blades. Flowers 3, large, violet (when dry) and forming a lax spike. Spathe of 2 dissimilar herbaceous valves, the outer one stem clasping, ovate-lanceolate, multistriate, elongate, inner one a little shorter, encircling the tube of the flower; tube as long as the inner valve of the spathe, bent forward near the limb, 3 lines long; upper outer segments of the perigone oblong, obtuse, with curled undulating margins; upper inner segment convex on the back, standing forwards from the 3 lower segments, all 1½ inch long, 8 lines broad; with a yellow mark running down in a line to the base and surrounded by a rhombic dark violet border, the central one elongated, 18 lines, the 2 others 15 lines long, and 5 lines broad.

Allied to *Gladiolus inflatus Thbg.*

11.—GLADIOLUS VINULUS (sp. nov.) Klatt.

G. cormo ovoideo tunicis fibroso-areolatis; caule arcuato firmo tereti folioso; foliis 6 superpositis, 2 inferioribus ad vaginas reductis apice sanguineis, folio tertio elongato late linsari-ensiformi acuminato glabro, tribus superioribus breviusculis, omnibus membranceis margine et nervo medio prominentibus; floribus 3-6 secundis carneis spicatis; spathis herbaceis inæquivalvibus, valva exteriore basi amplexicauli elongata late ovato-lanceolata carinata acuta, inferiore dimidia parte breviore ovarium et tubum amplectente apice bifida; perigonii tubo curvato cylindrico infundibulari, segmentis tubo æquilongis subobtusis.

Corm ovoid, 5 lin. in diameter, outer tunics consisting of meshes. Stem flexuose, 1-1½ ft. in height, simple, terete. Leaves superposed, 6, the two at the base, where they sheath the stem, violaceous above, the third elongate, as long as the stem with the flower spike, broadly linear-ensiform, strongly nerved in the middle and at the margins, blade of the three upper leaves abbreviated. Spathe inæquivalved, herbaceous, outer valve broadly ovate-lanceolate, striate, elongate, nearly 2 in. long, the inner 1 in. only, enfolding the ovary and tube, bifid at the apex. Perigonium flesh-colour, tubular, subringent, with a 6-parted limb, segments unequal, upper middle one twice as broad as the others, ovate, incurved, 1 inch long, 8 lines broad, the lateral ones 4-5 lines broad, the three lower marked with a yellow lanceolate spot surrounded above by a semicircular violet-blue line running down to the base of the segment. Stamens shorter than the style with the broad fimbriate stigmas.

Allied to *G. inflatus Thbg.*

12.—GLADIOLUS MacOwanianus, (sp. nov.) Klatt.

G. cormo ovoideo, tunicis fibroso-areolatis, caule simplici tereti curvato glabro, foliis 6, duobus ad basin vaginæformibus viridibus, 4 productis

lineari-ensiformibus acutis coriaceis marginatis medio costatis; floribus 4-6 *spicatis secundis albido-carneis, ex sicco purpurascentibus; spathæ valvis inæqualibus herbaceis striatis, valvâ exteriore late ovato-lanceolata naviculari basi amplexicauli, interiore apice bifida, perigonii tubo infundibulari-cylindrico violaceo curvato spathâ æquali; lacinia suprema oblonga mucronulata, laciniis exterioribus parum brevioribus, tribus inferioribus ovato-lanceolatis macula violacea cordato-spathulata notatis; stigmatibus filamenta superantibus repandis fimbriatis.*

Hab. In clivis pone Hout's Bay. October, 1884, *Hb. M.O.* 2065.

Corm ovoid, 6 lin. in diameter, tunic reticulated. Stem perfectly glabrous, 1 ft. high, round, curved. Leaves dissimilar, two at base reduced to sheaths only, but green, the other four linear-ensiform, rigid, costate at the margin and the middle, gradually attenuated into an acute point, the lowest perfect leaf 8-10 inches long, 4 lines broad. Flowers 4-6, pale flesh colour, purplish in drying, forming a spike 4 inches high, unilateral. Spathe large, broad and acute, outer valve 2 in. long, and on either side of the keel 4 lines broad, inner valve 1½in. long, split at the top, both many-nerved. Perigone tube curved, equalling the spathe, 1½ in. long, enlarged at the top. Uppermost segment oblong, mucronate, 1½ inch long, 10 lines broad, remote, lateral ones 1½ inch long, 5 lines broad, the three inferior ovate-lanceolate, 1½ inch long, 4 lines broad, with a cordate spathulate violet spot. Stamens shorter than the fimbriate stigmas. Capsule ovoid, 6-striate. Seeds oblong, broad-winged.

13.—Antholyza Revoluta, Burm.

In clivis graminosis Montis Leonis, prope Sea Point, juxta Urbem, Jun. 1882. *Hb. M.O.*

14.—Watsonia pilosa, (spec. nov.) Klatt.

W. caule teresti simplici erecto v. apice reflexo, foliis lanceolato-ensiformibus coriaceis longe vaginantibus, 7-nerviis, nervis 3 latis prominentibus, 4 secundariis, interspatiis pilosis; floribus 3 terminalibus coccineis v. luteo-coccineis; spathis sub-æquivalvibus, valva exteriore ovato-lanceolata acuta multinervata nervis sub apice ramosis, interiore tubum perigonii rectum cylindraceum æquante et involvente, fauce ampliata curvata nervata, lacinis ovatis apiculatis inæqualibus, lacinia suprema elongata, filamentis antheris subduplo longioribus stigmatibus spathulatis fimbriatis.—Hab. In montibus pone Simon's town, Aprili, Majo, 1884. *Hb. M.O. No.* 2510.

Stem round, simple, erect, or reflexed at the apex, 1½ ft. high. Leaves 5, lanceolate, coriaceous, unequal, divided by the middle nerve which as well as the marginal ones is very thick. Interspaces between the seven leaf nerves and those of the long sheaths beset with long

soft hairs. Flowers three, at the top of the stem, close set, unilateral, scarlet or yellow-scarlet. Spathes green, nearly equal in length, the outer valve ovate-lanceolate, acute, many-nerved, nerves often ramified, inner valve as long as and enfolding the erect tube, faux as long as the tube, cyathiform, curved. Segments ovate with an erect mucro, unequal in length, the uppermost being largest and highest. Filaments a little curved, double as long as the anthers. Stigmas spathulate, fimbriate. Allied to *W. Meriana Ker*, and *W. coccinea, Herbt.*

15.—ACIDANTHERA EXSCAPA, Klatt.

Flores extus purpurei, violaceo-venosi, folia margine prominentia, nervus medius supra et subtus elevatus. Spatha ovarium et perigonii tubum semi-involvens—Zwarteberg, (Caledon) Sept. 1884, *legit Templeman.*

16.—TRITONIA LACERATA, Klatt.

In lapidosis ad pedem Montis Tabularis, occidentem versus. (Kasteel Poort) Oct. 1883, *Hb. M. O.*

17.—TRITONIA REFLEXA, Klatt.

In clivis ad latera Montis Tabularis occidentem versus, Sept. 1883, *Hb. M. O. No.* 2234.

18.—BABIANA PURPUREA, Ker.

Inter lapides ad latera montis Tabularis, Sept. 1883, *Hb. M. O.*

19.—BABIANA RINGENS, Ker.

In arenosis Planitiei prope Duiker Vley, Oct. 1883, *Hb. M. O. No.* 2477.

20.—BABIANA SAMBUCINA, Ker.

In sabulo alto pone Van Kamp's Bay, ad ped. montis Tabularis, Sept. 1883, *Hb. M. O. No.* 2559.

21.—BABIANA PLICATA, Ker.

In lapidosis ad pedem Montis Diaboli, Junio, 1884, *Hb. M. O.*

22.—MICRANTHUS TRITICEUS, Klatt.

In humidiusculis Montis Muizenberg, Nov. 1884, *Hb. M.O.* 1935.

23.—HOMERIA SPICATA, Sweet.

Ad latera Montis Zwaarteberg, (Caledon) legit Templeman, Sept. 1884.

24.—MORÆA MIRA (spec. nov.) Klatt.

M. bulbo-tubere squamoso, squamis areolatis, caule pumilo teretí 3-foliato apice 3-pedunculato, foliis superpositis alternantibus lineari-lanceolatis acutis basi vaginantibus septemnerviis marginibus ciliatis caulem longe superantibus, folia infima ad vaginas reducta; pedunculis flexuosis v. erectis breviter pilosis; floribus caeruleo-violaceis pedicellatis, pedicellis inclusis teretibus; spathis terminalibus 3-floris plurivalvibus; valvis exterioribus inæqualibus herbaceis multistriatis ovatis acutis margine membranaceis ciliatis basi imbricatis, valva superiore elongata; valvis interioribus membranaceis lineis viridibus striatis; perigonii laciniis conformibus horizontaliter patentibus oblongis circinatim venosis, laciniis exterioribus basi maculâ luteâ punctisq. binis viridibus ornatis, interioribus barbatis; genitalibus columnaribus; pollinis granula ignea, stigmatibus bifidis apice filiformi-fissis; antheris cordatis obscure violaceis apice in setulam longam arcuatam excurrentibus. Hab. In humidis ad latera montis Zwaarteberg pone thermas, Oct. 1884, *legit Templeman, Hb. M.O. No.* 2612.

Bulb-tuber scaly, scales reticulate; stem dwarf, 1-2 in. high with 3 leaves, and 3 flower stalks on the summit. Leaves superposed, alternate, linear-lanceolate, acute, sheathing and stem-clasping at the base, 7 nerved, margins beset with fine hairs, much longer than the stem, 4-5 inches long, 1 line broad, striate; the undermost leaf reduced to a sheath. Flower stalks curved or erect, hairy, 6-10 lines long. Flowers blue-violet. Peduncles round, inclosed. Spathes terminal, 3 flowered, many valved. Outer valves herbaceous, multistriate, membranous and ciliated at margin, acute; lower valve 9 lines long, clasping the upper valve, which is much elongated, 1¼ in. long, 4 lines broad. Inner valves membranous, with green lines. Segments of the perigone equal, oblong, patent, with veins twisted serpentinely, 6 lines long, 2-3 lines broad. Outer segments with a basal yellow stripe which is triangular-cuneate with two green points above. Inner segments bearded. Stamens connate with the style into one column. Anthers heart-shaped, dark violet, ending above in a long curved bristle. Pollen fiery-red. Stigmas bipartite, divided into long filiform points.

25.—ROMULEA UNCINATA, Klatt.

In arenosis pone Van Kamp's Bay, ad pedem Montis Tabularis, Aug. 1884. *Hb. M.O. no.* 2665; *et in arenosis prope Sea Point, juxta Cape Town, Sept.* 1884, *Hb. M. O.* 2616.

27.—ROMULEA BULBOCODIOIDES, Eckl.

In arenosis Planitici prope Urbem, Junio, 1884. *Hb. M.O. No.* 2573.

28.—GALAXIA PURPUREA, Klatt.

In argillaceis, ad latera Montis Leonis, Sept. 1882. *Hb. M.O. No.* 2552.

29.—HESPERANTHA QUINQUANGULARIS, Eckl.

In graminosis rupestribus pone Van Kamp's Bay, Sept. 1884.

30.—HESPERANTHA FLEXUOSA, Klatt.

In clivis ad pedem Montis Tabularis, septentrionem versus. Sept. 1882. *Hb. M.O. no.* 2386.

31.—GEISSORHIZA SABULOSA, spec. nov. Klatt.

G. bulbo squamoso, squamis imbricatis; caule tereti canaliculato glabro simplici curvato folioso, foliis inferioribus binis oppositis lineari-ensiformibus obtusis marginatis, 7-nerviis, caule brevioribus, caulinis inflato-vaginatis; floribus 2-5 *campanulatis secundis æquilateralibus laxe spicatis; spathis bivalvibus membranaceis, valva exteriore late oblonga obtusa apice purpurea rhachim amplexante et inferiorem valvam lanceolatam apice bifidam includente; perigonii tubo subnullo, laciniis obovatis inæqualibus, exterioribus extus purpureostriatis; stigmatibus incurvatis elongatis fimbriatis, capsula obovata. Hab. Inter frutices in arenosis clivis pone Van Kamp's Bay, Sept.* 1881. *Hb. M.O. No.* 2273.

Bulb ovate, covered with many brown imbricating scales, split into equal segments. Stem 6 inches high, simple, roundish, furrowed. Stem leaf convolutely sheathing downwards, basal leaves 2, opposite, linear-ensiform, stiff, obtuse, shorter than the stem, with seven prominent nerves. Flowers 2-5 on a flexuose rachis, forming a unilateral short spike. Spathe membranaceous, 2 valved, outer valve broad, oblong, obtuse, scarlet at the tip, including the apically bifid lower one. Tube wanting. Segments unequal in length, obovate, the outer ones purple-streaked. Stigmas recurvedly elongate, fimbriate. Capsule obovate.

32.—GEISSORHIZA HUMILIS, Ker.

In arenosis summi Montis Muizenberg, Sept. 1883, *Hb. M.O. No.* 2609.

33.—GEISSORHIZA LUTEA, Eckl.

Ad latera montis, Zwartberg, (Caledon), pone thermas, Oct. 1885, *legit Templeman, Hb. M.O. No.* 2609.

34.—GEISSORHIZA PUSILLA, Klatt.

Ad latera montis Zwartberg, (Caledon), pone thermas, Oct. 1884, *legit Templeman, Hb. M.O. No.* 2611.

35.—GEISSORHIZA ROCHENSIS, Ker.

In arenosis hyeme inundatis in valle Groenkloof, Sept. 1883, *Hb. M.O. No.* 2281.

36.—LAPEYROUSEA FISSIFOLIA, Ker. *Bot. Mag. tab.* 1246, *non Jacq.*

In lapidosis graminosis summi Montis Leonis pone Urbem, Sept. 1883, *Hb. M.O. No.* 2469.

37.—LAPEYROUSEA CORYMBOSA, Ker.

Var. purpurea, Genitalibus albis; Floribus mediocribus.—In arenosis depressis, Visch Hoek, juxta Sinum False Bay, Sept. 1883, *Hb. M.O. No.* 2284, a. *Var. grandiflora, Genitalibus obscurè violaceis. Floribus obscurè violaceis, magnis.—In montibus pone Houw Hoek, Sept.* 1883, *Hb. M.O. No.* 2284, b.

38.—LAPEYROUSEA FABRICII, Ker.

In argillaceis planitiei Capensis prope Maitland, Oct., 1883. *Hb. M.O. No.* 2517.

39.—IXIA LEUCANTHA, Jacq.

In lapidosis clivis Montis Tabularis, sinum 'Hout's Bay' spectantibus, Oct., 1884. *Hb. M.O. No.* 2555.

40.—IXIA CRATEROIDES, Ker.

In depressis subhumidis ad pedem montis Winterhoek, (Tulbagh.) Oct. 1884. *Hb. M.O.* 2480.

41.—IXIA MACULATA, Linn.

In arenosis in valle 'Groen Kloof,' Sept., 1883. *Hb. M.O. No.* 2277.

42.—IXIA CAPILLARIS, (MORPHIXIA) Ker.

Inter lapides ad pedem Montis Tabularis occidentem versus, Oct., 1883. *Hb. M.O. No.* 2481.

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